SCIENTIFIC AMERICAN

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THE CHICAGO DRAINAGE CANAL.

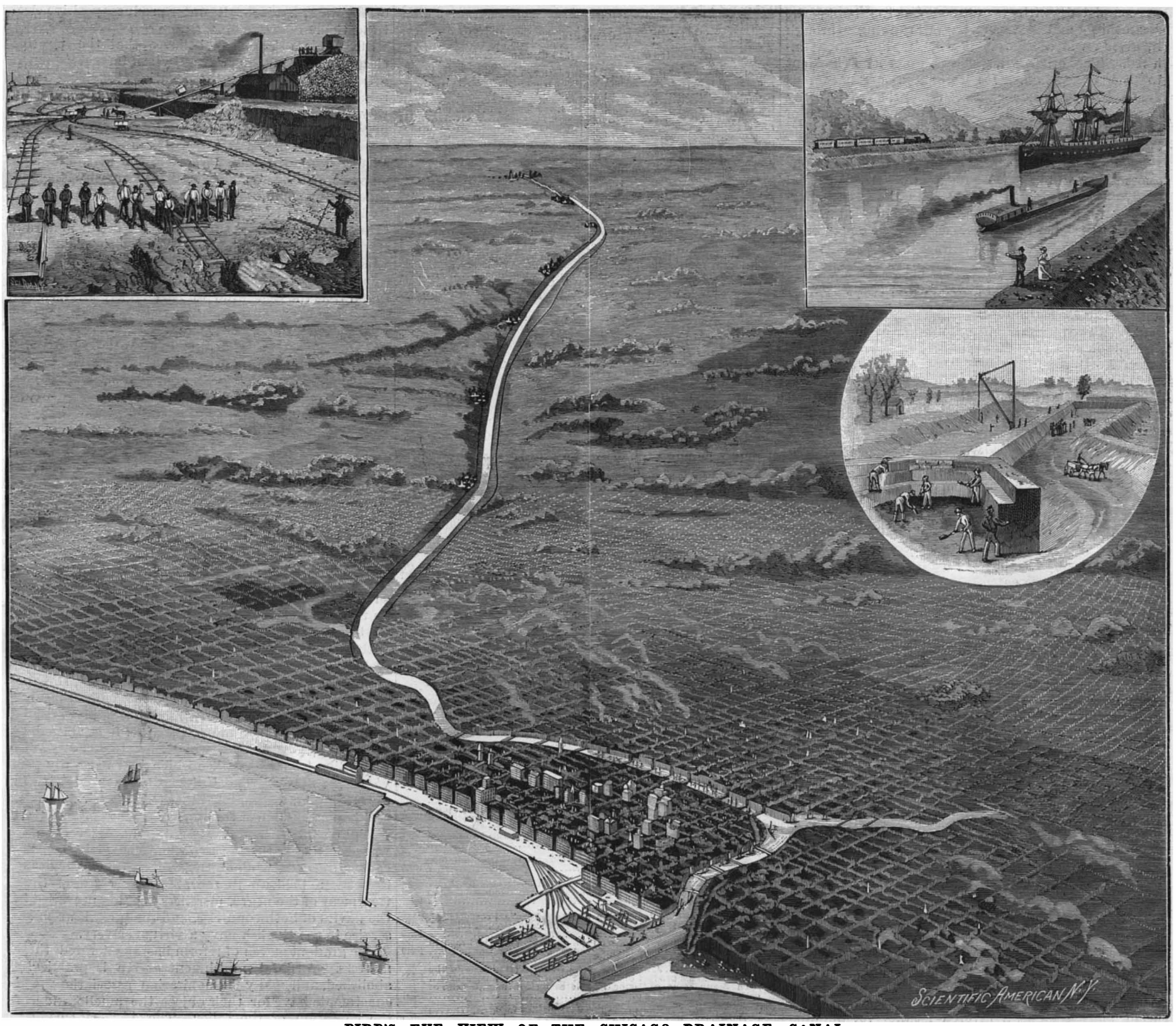
In a recent issue of this paper we described the operations in progress on the great Chicago drainage canal, a work which, viewed from the aspect of civil engineering and of sanitation, is one of the greatest ever undertaken by man. Lake Michigan is separated by a low divide from the Des Plaines River, this divide lying in the city of Chicago. The Des Plaines River, running from the north and west, then to the south, runs into the Illinois River, uniting with the Kankakee River; the Illinois then runs into the Mississippi, a short distance above the mouth of the Missouri River and on the opposite side thereto. Within the city of Chicago is the stream, now a malodorous one, termed the Chicago River, which empties into the lake, delivering thereto a quantity of Chicago sewage.

Alarmed for the quality of her drinking water, which is taken directly from the lake, Chicago has built tunnels far out into the lake, with intakes at their end, whence the city water is taken. But this is only a temporary expedient; as the city increases in population, the sewage delivery to the lake becomes larger and larger in volume and its area of contamination becomes greater.

Two miles from the bed of the Chicago River, which latter flows into the lake, is the Des Plaines River, whose waters ultimately reach the Gulf of Mexico. For some time past much of the sewage from the city has been diverted from the lake by pumping and by the natural contour of the ground and has flowed into the Des Plaines River. By piercing the two miles of the divide just described, communication could be opened between the great lakes and the Gulf of Mexico. The next proposal was to send all the sewage into the gulf. The use of a natural river bed for the sewage of the great city being inadvisable, the operation of constructing a canal 35 miles long from Chicago to the city of Joliet was commenced, and earth was first broken on September 3, 1892, a day named "Shovel Day" by the enthusiastic engineers. Since that period the work has been vigorously prosecuted. For the excavation the most extensive machinery was employed, and if ever the Nicaragua Canal or Panama Canal is pushed to a successful conclusion, much may be learned by their constructors from the operations on the Chicago Canal.

Our bird's eye view is designed to show at a glance what is to be done. The mouth of the Chicago River is seen on the lake front. A short distance back from the lake, at Robey Street, Chicago, the canal proper begins, and it can be traced in the illustration winding through the country until it reaches Lockport, its southern terminus. Beyond Lockport, certain subsidiary changes will have to be made to carry the flow successfully through Joliet, but with the construction of the canal from Robey Street to Lockport, the main work is done. The cross section of the canal gives it various bottom widths. For some sections a bottom width of 202 feet, with side slopes two to one, is given it. This is the largest section of the canal, and is followed through the rock of certain sections in order to avoid any further difficult operations. But in softer ground, where the canal can be enlarged at any time, the bottom is reduced to 110 feet. The larger section will accommodate a flow of 600,000 cubic feet per minute, a sufficient provision for a population of 3,000,000 of people. The narrow channel is about half this capacity, and is therefore adapted for the present population of Chicago. Another portion of the canal has the width at the bottom of 160 feet, with vertical sides. The grade of the two first named widths of the canal is 1 to 40,000; the last named width is given a grade of twice this amount, so, though of medium width, it has the full capacity of the widest portion of the canal.

Chicago datum designates the level of the low water of Lake Michigan in 1847. At Robey Street, where the



BIRD'S EYE VIEW OF THE CHICAGO DRAINAGE CANAL.

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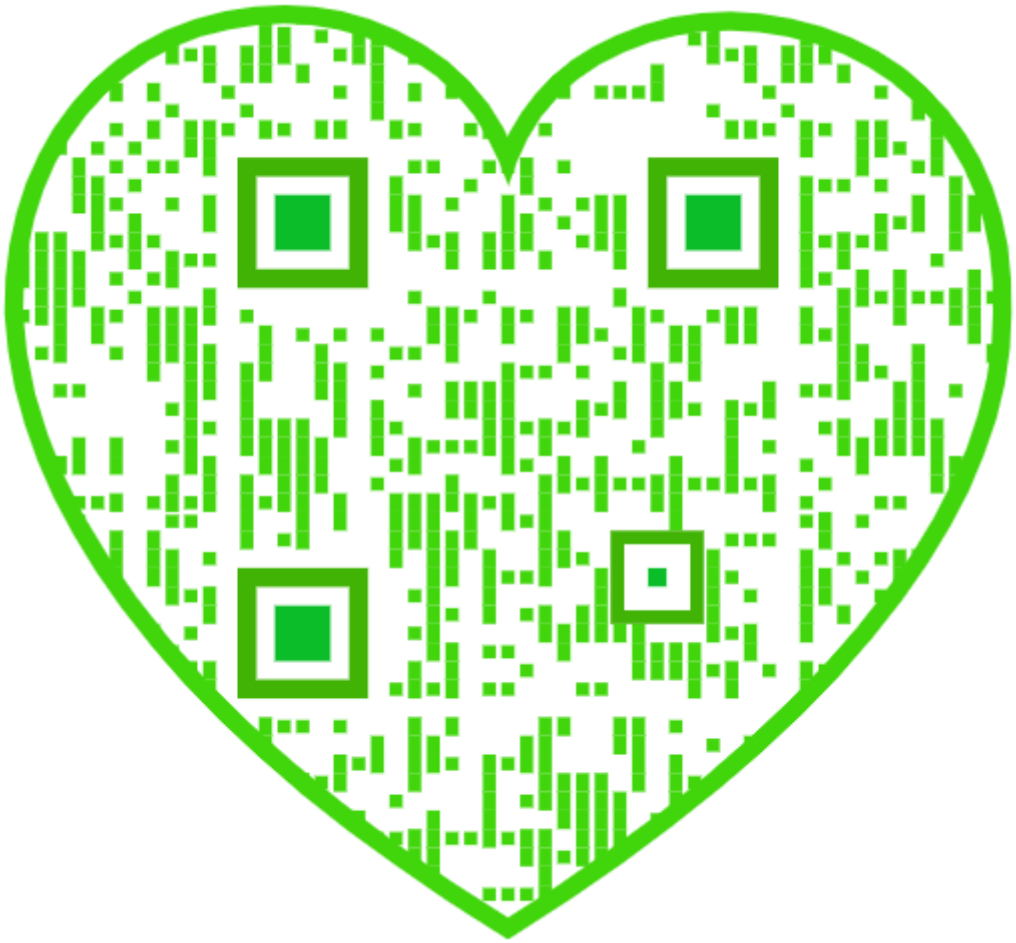

canal begins, the bottom is 24.488 feet below datum. The entire descent would be sufficient to send a very rapid current through it, but at Lockport controlling works are established, consisting of gates or movable dams, by which the flow of water from the canal into the Des Plaines River beyond it is controlled. Thus the course of the Chicago River, whose waters now run to the lake, will be reversed; the lake will in the future run into the Chicago River and down the canal, and the outflow will be regulated by a dam at Lockport in the distance.

The Des Plaines River, whose stream is subject to the widest fluctuation, has also been taken care of. Accordingly, diversion works, as they are termed, are established, one of our smaller views showing the work in progress upon them, to keep the water out of the canal. Thirteen miles of new river channel were excavated parallel with the main drainage canal, nineteen miles of levee were built between river and canal for the same purpose, while at the head of the river diversion a spillway is to be built for letting surplus water run back into the lake, as arrangements have not yet been made to carry the entire flow of the river with that of the canal to the city of Joliet below Lockport. It will thus be seen how very perfect the whole system is.

Looking at the bird's eye view, the terminus of the canal marks Lockport. Below Lockport the sinuous river can be traced to Joliet. This portion is a relatively steep declivity, involving a fall of some 42 feet in a distance of 4⅓ miles. Lockport, therefore, is the critical point; the raising or lowering of the control gate a few inches means an immense difference to the flow through the canal. Up to the limit of the canal's capacity the level of the great lakes rests in the hands of the engineer.

It is not only as a drainage canal that the work is being prosecuted. The Chicago people fondly hope that it will eventually be a fully developed ship canal, and some believe it possible that communication with the ocean may be made by it. Our view of the canal as completed, with a railroad on the bank, the steamship and steam barge running through it, gives an idea of what it will be like when finished. The other view shows operations incident to the excavation. Its estimated costs exceeds $21,000,000, and some eighteeen months from to-day it is hoped it will be completed. A number of very different types of excavating machines were employed with various success upon different sections of the canal, as these involved the best appliances that could be devised for the purpose. A special study of them is highly interesting, and for such purpose our readers are strongly recommended to the issue of this paper of October 20, 1894, the one already alluded to.

Birds and the Farmer.

Dr. C. Hart Merriam, chief of the division of ornithology of the Agricultural Department, has just made a report on the results of his examination of the contents of the stomachs of hawks, owls, crows, blackbirds, and other North American birds that are supposed to be the enemies of farmers. He shows that the popular notions about hawks and birds, for the slaughter of which many States gave bounties, are altogether erroneous. Ninety-five per cent of their food was found to be field mice, grasshoppers, crickets, etc., which were infinitely more injurious to farm crops than they. The charge against crows is that they eat corn and destroy eggs, poultry, and wild birds. Examination shows that they eat noxious insects and destructive animals, and that although 25 per cent of their food is corn, it is mostly waste corn picked up in the fall and winter. With regard to eggs, it was found that the shells were eaten to a very limited extent for the lime. Crows eat also ants, beetles, caterpillars, bugs, flies, grubs, etc., which do much damage. The cuckoos are also found to be very useful birds. —Rochester Herald.

A Model Suburb.

Since January, 1893, up to date there have been over 2,000 houses built in San Francisco, of which it is estimated 15 per cent have been erected in Richmond. Miles and miles of streets have been graded and sewered. A scientific system of sewerage, with proper outlet to the bay, has been laid down, and to-day, it is said, Richmond is the only properly sewered district in the city. It also enjoys excellent transportation facilities, and when the Sutro road is completed and the Geary Street line continued it will, with those roads now running through the district, be ahead in this respect also. Salt water mains have been laid in the district for private baths, flushing sewers, sprinkling streets and putting out fires, for which purposes it is superior to fresh water. The Spring Valley mains give an abundant supply of good fresh water. The location, scenery and shelter are unsurpassed. Its closeness to the park and bay, coupled with the advantages enumerated above, make Richmond, with its magnificent marine views, a favored locality for building homes.—Daily Call.

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THE ELECTRIFICATION OF THE AIR BY RAIN DROPS AND WAVES.

As the earth rotates on its axis it is in constant receipt of energy from the sun, which energy manifests itself in the production of the tides, of the winds and in the maintenance of the existing temperature. As the earth rotates, the great tide disturbances go round and round it, acting as a drag upon its motion, so that it is easy to see how its rotation is being resisted by the lines of gravitational force, much as a plate of metal is retarded when rotated in a strong magnetic field. The sun, expending its energy in the evaporation of water, released again from the upper regions of the air as rain, and in producing winds which form waves upon the ocean, produces electrical disturbances which have recently been investigated by Lord Kelvin and others, with quite curious results.

A recent paper by Lord Kelvin, communicated to the Philosophical Society of Glasgow, has brought forward two very curious incidents of the electrification of air by rain drops and by waves on the sea. By investigation with apparatus adapted for the purpose, it was found that if a drop of water falls through air a slight electrification of the air is produced undoubtedly, but if the drop is checked in its fall, striking about a solid body or upon a liquid surface, such as that of water, the air is much more strongly electrified, the point of electrification being the place where the water drop strikes. This is not all; experiments were made with salt and fresh water, and it was found that if a drop of fresh water strikes a surface of salt water or a solid body, the air becomes negatively electrified, while if salt water is used of sufficient saltness, the air will be positively electrified.

On the earth many examples of such impact exist; fresh water cascades present them; the waves of the sea, of fresh water lakes and the falling of rain are all instances. When the ocean is calm and rain falls upon it the air is at once negatively electrified, and may be raised many volts in potential. Again, in a dry wind, when the waves are constantly breaking, the impact of salt water against salt water produces positive electrification.

Sir William Thomson believes that the positive electrification of the waves by self-impact is much greater in amount than the negative electrification by rainfall. The positively electrified air also finds its way more quickly to great heights than does the negatively electrified, the greater part of which, he says, may be quickly lost into the sea. Thus we have conferred upon the mighty ocean the attributes of a gigantic electric machine, and just as with the old time plate machine one or the other kind of electricity is generated according to whether its rubber or prime conductor is grounded, so the ocean in a rain storm is a generator of negative electricity and in a wind storm is a generator of positive electricity. In some of his experiments on the seashore, Lord Kelvin found that the east wind at Arran gave strong positive electricity. This he attributed to the fact that in such a wind, even if gentle, countless waves were breaking all over twelve nautical miles of water lying to the eastward of that shore. If this is so other winds should produce positive electrification at places whose exposure is different from that at Arran.

In our this week's SUPPLEMENT we give Lord Kelvin's paper in full.

SUPREMACY OF THE SEA.

Supremacy at sea, whether in the commercial or the warlike sense, has always been a source of pride for the nation possessing it. England in the old days of the walls of oak and muzzle-loading cannon mounted in great broadsides of two and three tiers high was willing to sacrifice anything and everything to win victories at sea. A people boastful of their freedom submitted to the atrocities of the press-gang simply on the plea that his majesty's ships must have men. On board of the ships relentless discipline combined with the frightful sanitary condition of the overcrowded vessels, bringing about virulent ship fever, made life afloat an absolute horror. Smollett, Douglas Jerrold, Defoe and others have pictured old time life at sea. Dibdin wrote his spirited lyrics in praise of the sailor's life under the inspiration, it is alleged, of the English government, who wished to do away with the dislike for naval service which had naturally pervaded the people. The United States, progressive in everything, unfortunately inherited English methods, and imported some of the worst elements of old time discipline into her navy. While the older country was proclaiming that a slave who touched its soil became a freeman, while in the United States the slave States were held up to reprobation because of their treatment of the negro, merciless flogging prevailed in the navies of both countries, and the press laws made service in the English navy a virtual slavery.

The gradual march of reform has ameliorated these matters. Corporal punishment at sea is practically abolished, and many humanitarian associations and enactments have for their object the amelioration of the condition of the sailor. The old spirit survives, and the merchant and naval marine are objects of

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solicitude and pride for every nation. Years ago the English, striving with bulldog pertinacity for the mastery of the sea, found themselves surpassed by other nations in the building of sailing ships. The fastest ships in the British navy were often captured ones which had been launched at French dockyards. In this country the American fore-and-afters won high reputation, and the name of Baltimore clipper is a matter of history. These vessels outpointed all other seagoing ships. Ever since the days of Peter the Great, of Russia, men had been striving to force ships to windward, and every degree of pointing gained meant a great deal in the days preceding steam. As long as it was a question of sailing ships, America and France were most successful in their models, and we were active competitors for the carrying trade of the world. The wharves of our seaboard cities were described as appearing like forests of masts.

Now steam rules supreme. Enormous foreign capital is invested in steam vessels, and the United States has taken an inferior position in ocean commerce, and the forests of masts have departed. English tramp ships pervade the whole water area of the globe, and English liners connect the British Islands with every part of the globe. The government of England, directly or indirectly, subsidizes many of these lines, and their stockholders are content with smaller dividends than perhaps would be acceptable here. The price paid for modern supremacy is a high one. A few years suffice for the fastest ships to be outclassed by newer ones, but at an immense expense in the consumption of fuel. The race across the ocean is run now by mechanical force and skill rather than by fine models.

When this paper reaches our readers, the St. Louis will have finished her first voyage across the ocean. American in design and appearance, commanded by officers who are at least citizens of the United States in the legal sense, the ship will carry the American flag into Southamptom under auspices pleasing to the American patriot. As such a person looks back on America's record in the steam marine, he can but hope that the American Line will have a better fate than has been accorded to some of the other American Atlantic steamship lines, its predecessors.

The St. Louis is built for transatlantic service. In one week, probably, she will reach Southampton, and there, within about three days, she will be discharged, coaled, reloaded, and on her voyage back, arriving in New York in time to start on her third trip within three weeks from the date of her first voyage. No ship of war can do this. In case of war, ships like the St. Louis will do work that no other type of vessel can accomplish, and such ships can only be the product of such service. The commercial and naval necessities of the country require that every possible encouragement should be extended toward the building of many other vessels such as the St. Louis.

Southampton should not be the only European port to see our flag floating over a ship of American materials and American build. If proper encouragement were given, all the principal ports of the world might renew their acquaintance with a once familiar, now seldom seen object, the American flag over an American deck.

How Diamonds, Rubies and Sapphires are now Floated to Prove their Genuineness.

Mr. Arthur Chamberlin, in the Mineral Collector, says: An accurate scientific method has at last been discovered, whereby precious stones may be distinguished from the fraudulent gems which are now so numerously manufactured in the laboratories of Paris and other Continental cities. This is by testing them for their specific gravity, but not by the scales occasionally used for large stones, and which, however delicate, are unreliable.

The new means of detection of bogus gems is simple and ingenious, and is likely to be widely adopted in the jewelry trade. It is the chemist who has added this knowledge to the lapidary's art. Several liquids have been discovered, which are more than three and one-half times as dense as water, and in which, therefore, the amethyst, the beryl and other light stones will actually float.

The most useful of these liquids is methylene iodide, which has a specific gravity of 3·3, and in which the tourmaline readily floats. Moreover, it is not corrosive or in any way dangerous. It being impossible for the lapidary to prepare a number of liquids each having the specific gravity of a different gem stone, the methylene iodide is easily diluted by adding benzine to it. Each drop of benzine added makes the liquid less dense, and so it may be used to separate the tourmaline and all the lighter gem stones from each other.

If it be doubtful whether a certain gem be an aquamarine or a chrysoberyl, all that is necessary is to place it in a tube of the liquid, together with a small fragment of true aquamarine to serve as an index. If it be a chrysoberyl, which has a specific gravity of 3·6, it will sink like lead. If it be an aquamarine, which has a specific gravity of 2·7, it will float. If the liquid be then stirred and diluted until the index fragment is exactly suspended, the gem also will neither float nor sink, but will remain poised beside it. This method may be adopted with all of the lighter stones.

But for heavier gems, like the carbuncle, the jargoon, the sapphire, the ruby, the spinal, the topaz and the diamond, a different liquid is necessary. This has lately been discovered by the Dutch mineralogist Retgers. He has found a colorless solid compound which melts at a temperature far below that of boiling water to a clear liquid five times as dense as water, and therefore sufficiently dense to float any known precious stone. This compound is the double nitrate of silver and thallium.

Its most remarkable property is, that it will mix in any desired proportion with warm water, so that by dilution the specific gravity may be easily reduced. This fused mass may be reduced in density by adding water, drop by drop, so as to suspend in succession carbuncle, sapphire, ruby and diamond.

These tests of precious stones may be made in a few minutes, and are absolutely reliable, as all stones of the same nature have the same specific gravity. None of the bogus rubies or diamonds have the same weight as those they are made to imitate.

Voting by Machinery.

The days of ballot box stuffing and other modes of cheating at elections appear to be numbered. Inventive genius has provided machinery that will not lie and will not allow deception at the polls. The New York Herald says:

A vote by machinery is the latest luxury indulged in by Westchester County. The city of Mount Vernon tried the experiment recently and pronounced it very good. The voter touches the button and the machine does the rest. Though not a machine in the political sense, this ingenious contrivance runs the voter to suit itself. Any man yielding himself to its insidious advances must vote willynilly or be forever shut out from the gracious sunlight. How this is will appear later on. At all events, the voters of Mount Vernon are mightily pleased with the results achieved.

One of the many beauties of voting by machine is that the eager citizen is not obliged to wait very long for results. The polls in Mount Vernon, for example, closed at nine o'clock at night, and a little more than a quarter of an hour later the full and accurate results of the election were announced in extra editions of the local press. No more anxious waiting about bulletin boards for the community that votes by machine! As soon almost as the last voter has ceased his pressure upon the magic button the result of the day's balloting is known beyond any question.

The Myers ballot machine, which was used so successfully in the above election, is so simple in device as to be easily and immediately comprehended. It consists of a sheet steel cabinet five feet square and seven feet high, which is lighted inside by a lamp, gas or electricity. The cabinet has two doors, an entrance and an exit door. After he has been duly scrutinized by the inspectors of election, the voter is allowed to enter the booth or cabinet by the entrance door, which closes behind him, automatically locking itself.

As soon as he has recovered from the shock of this sudden and rather awful imprisonment in a chamber of steel, the voter is able to realize what is expected of him. He finds himself confronted with vertical columns in colors, divided into as many spaces as there are candidates to be voted for. To the right of each name is a little knob which he must press in order to register his vote. Candidates of the democratic party are printed upon a yellow background, candidates on the republican ticket upon a red background, prohibition ticket candidates upon a blue background, and questions to be voted upon a white background.

The voter presses the knob at the right of the name of the candidate for whom he wishes to cast his ballot, and this vote is instantly registered in another compartment of the booth, which, at the opening of the polls, has been locked under seal by the inspectors of election. It is to be observed that all the names of candidates for the same office are printed in the same line, so that a vote for one of them, by a pressure of the knob opposite the name, locks the knobs opposite the other names, so that they cannot be used until the voter leaves the box. The voter, by pressing the knobs in succession, as his political allegiance dictates, votes either a straight or split ticket as he desires. He then passes out through the exit door, which is immediately and automatically locked behind him. The entrance door to the booth will not open until the exit door, which releases the voter, has closed and locked after him.

One of the beauties of the machine is that it shuts down with hard mechanical precision upon attempts at repeating. As soon as a man has voted and retired from the booth by the first exit door the knobs opposite the names of the candidates are automatically locked, so that they cannot be made to register a vote. The springs which lock up the knobs are not released until the citizen passes through the second exit door and out into the polling place. As the outer exit door closes, the entrance door opens of itself, and the machine is ready for another voter.

This is a quick method of casting a ballot, and the law therefore has placed the time in which a voter should finish up his work at one minute. As soon as the polls are closed, the private compartment in which the registration of the votes has been going on is unlocked, and the figures are copied off and footed up in a very few minutes. The saving of time in the matter of securing complete and accurate returns can be easily appreciated. It is estimated that, even in densely populated districts, returns, which under the old system would require hours of figuring to complete, would be ready for promulgation in a very few minutes.

The colored columns containing the names of candidates bear this caption in each case: "Democratic Ballot—The ballot and counting knob supports are Yellow. Republican Ballot—The ballot and counting knob supports are Red. Prohibition Ballot—The ballot and counting knob supports are Blue."

The ballot machine can supply six party columns for thirty-five knobs in each column, or a total of 210 knobs. The Presidential electors are all voted for by the use of one knob; therefore, in the State of New York the machine has capacity to vote for seventy candidates for each party, or 420 candidates in all.

On all offices where only one is to be elected, voting for any one automatically locks the other two. The voter has, in all cases, freedom of choice to cast only one vote each for as many candidates as are to be elected. It is the claim of the inventors that any illiterate or even a blind voter can vote a straight or mixed ticket, or a part ticket, without assistance.

The following extracts from Chapter 127 of the Laws of 1892 provide for the use of the Myers Automatic Ballot Cabinet in town elections:

"Section 1. Hereafter, within this State, any town may, by a majority vote of the town board, . . . determine upon, purchase and order the use of one or more of Myers Automatic Ballot Cabinets, . . . for the purpose of voting for the officers to be elected at such election, and for registering and counting the ballots cast thereat.

"Section 2. The ballot by which the elector chooses or votes there [here, the reader will notice, the voter votes by ballot described precisely like the present ballot, and that he counts by a knob] in said Myers Automatic Ballot Cabinet shall be in secret, and shall be a cardboard or paper ticket, which shall contain written or printed, or partly written or partly printed, the names of the persons for whom the elector intends to vote, and shall designate the office to which each person so named is intended by him to be chosen, and shall not contain any other printed or written device or distinguishing mark, excepting a heading or caption of its political or party designation, of not exceeding five words, and may be of different colors, and contain index hands pointing toward the knobs by which the elector counts and registers his ballot. . . .

"Section 3. At the close of the polls at such election at which such ballot cabinet shall be used, the canvassers shall proceed to ascertain publicly the total number of ballots cast for each candidate for each office, as registered and declared by such ballot cabinet register, and such ascertainment of the results shall be deemed to be the canvassing of the votes cast at such election."

The city of Mount Vernon is so well satisfied with machine voting that its voters declare that they will never again use any other system.

Electric Illuminating of our Men-of-War.

The navy department has arranged for spectacular displays by the American war ships at Kiel, which can hardly fail to create a sensation. Admiral Kirkland's four ships will be especially well equipped for displays at night. Each is provided with two or more powerful search lights, and each will be resplendent with thousands of incandescent lights. As a special decoration, each will carry before and around the pilot house an immense shield representing the American coat of arms, the red and white bars and the stars on a blue background being reproduced by electric lamps.

The name of each ship will be brilliantly displayed in large electric letters running around the stern. In addition to these two special features, incandescent lights will be strung along each vessel's stem and stern from the water to the deck and along the deck rail from end to end, on both sides. Lights will be placed along the water line on each side, just high enough to be out of the swash, thus outlining the hull. More lights will be strung up the masts and down the side stays, and up and down and around the tops of the smokestacks. The lights will be set three feet apart and at a distance will appear to be unbroken lines. There will be about 2,000 of these electric lights on the New York and about 1,500 on each of the other three ships. The finest display on the vessels will be the electric shield, which will be sixteen feet high and extend back on each side of the pilot house twenty-four feet.

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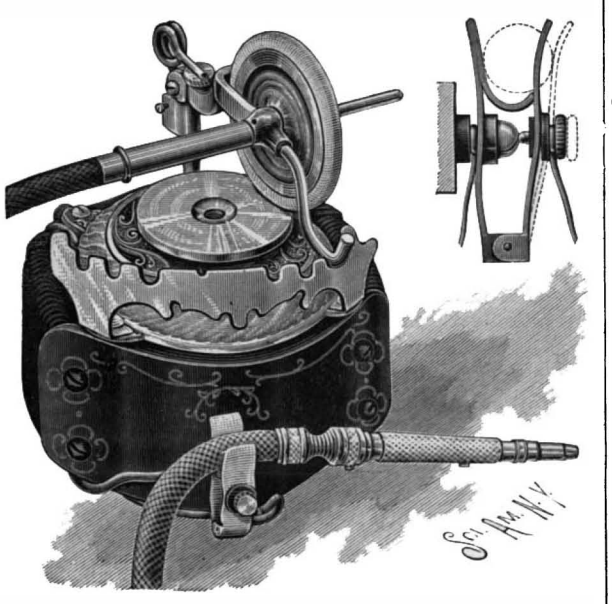
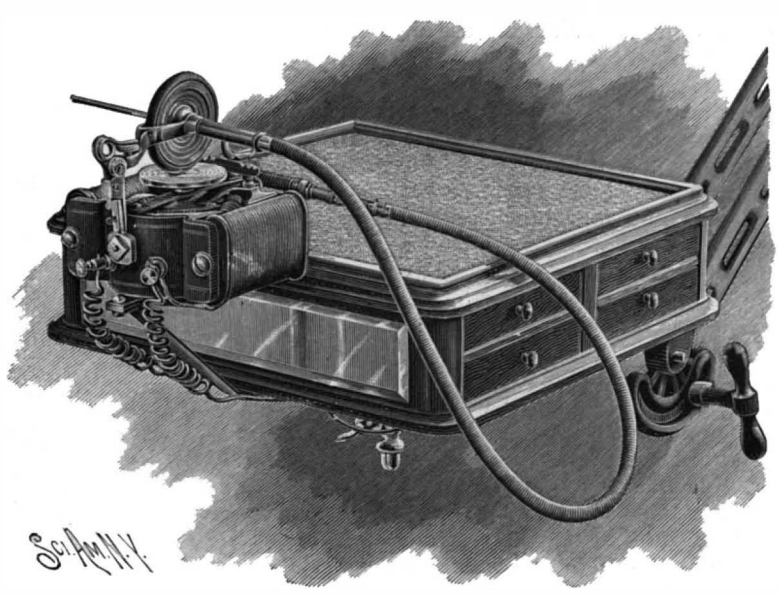
AN ELECTRIC DENTAL ENGINE.

The dental engine shown in the accompanying illustrations is designed to materially lessen the labor of the operator, who can, by the use of this improvement, at all times stand on both feet and work from each side of the chair with the utmost freedom. The invention has been patented by William E. Wheeler, D.D.S., No. 128 Lexington Avenue, New York City. In one of the views the engine is shown in operative position on the bracket table. The armature runs vertically between the field magnets, its shaft being cone shaped and fitted in a cone bearing at the lower end, while on its upper end a plane-face wheel, slightly dished in the center, is detachably secured. At one side is a socket-like bracket, insulated from the motor



WHEELER'S ELECTRIC DENTAL ENGINE.

body by rubber washers, and in the socket turns the vertical stem of a standard with which is connected a horizontal arm normally pressed downward by a spring. The outer end of the arm is bifurcated, and in the members are journaled the drill-operating spindle, on which is a friction wheel with a rubber rim contacting with the plane-face drive wheel on the upper end of the armature shaft. One of the members of the bifurcated arm has a downwardly bent extension adapted to engage a notched segmental support, and by lifting the arm and shifting the friction wheel toward the periphery of the drive wheel, the speed is increased, while by shifting the friction wheel toward the axis of the drive wheel the speed is proportionately diminished. By moving the friction wheel to the opposite side of the drive wheel the direction of rotation is reversed, and when the friction wheel is held centrally over the dished portion of the drive wheel, the rotation of the spindle ceases. A threaded extension on one of the bearing arms receives the internally threaded sleeve to which is secured the cable, in which is the flexible shaft of the drill, and on one side of the motor is an automatic switch and cable rest, shown in the small figure. It consists of a pair of spring clasplike arms, with which are connected the + and — terminals of the circuit wire. The arms are separated when the cable is supported in the rest, as



DENTAL ENGINE ON BRACKET TABLE.

indicated by the dotted lines, the circuit then being broken and the motor stopped; but when the cable is lifted out of the rest, as would be the case when work is being done, the terminals contact, close the circuit and set the motor in operation.

A PLUMB-LINE suspended a few feet from the side of a large building inclines a little from the perpendicular, because the weight is attracted by the edifice.

Guns and Bicycle Tires Made of Paper.

The wonders in the use of paper and wood pulp seem not likely to cease soon. The latest application of paper is for the manufacture of large guns. Guns have been made from leather pulp, and these are bound with hoops of metal. The leather pulp is, of course, hardened. There is also a core of metal set inside of the gun. The lightness of the leather cannon is an essential feature. The principal aim, however, is to secure a material which has some elasticity, so that the force of a heavy discharge will be broken gradually. This seems to be obtained in cannon made from a pulpy substance. Paper pulp answers the purpose, as numerous trials and experiments have proved; it possesses more elasticity than metal, and when hardened, is nearly as tough, hence this material is useful in the manufacture of articles requiring hard, efficient and elastic properties.

The body of the gun is made of paper pulp. The core is of metal, and made very much like the cores of ordinary cannon. The exterior of the cannon is wound with wire. About five layers of copper, brass or steel wire are firmly wound on, thus binding the cannon. Outside of the covering of wire are various bands of brass. These bands are set with uprights, through which rods extend parallel with the gun. There are lock nuts on each side of the uprights, and these hold the rods in place.

The Western Stationer states that a new bicycle tire is being tried, built on the compartment plan. The arrangement is such that a series of chambers are produced in the tire, each independent of the other, so that in case the tire is punctured with a tack or a sharp piece of glass, only part of the tire will collapse and the rider of the wheel can continue on his journey. If a pneumatic tire is punctured now, the entire tire will collapse wholly, and the machine is useless until repaired. The new tires are made of pulp produced from paper stock, and are of sufficient durability to permit usage on carriage wheels as well as bicycles. It is claimed that the tires manufactured on the compartment plan are as easy riding as the most elastic rubber pneumatics.

The Wheelwoman: French.

The learned Dr. Championniere, member of the Academy of Medicine, who has given minute and protracted study to the French wheelwoman, enlightens the world with the results of his observations. The Frenchwoman has used the wheel for four years, a term sufficient for the development of some definite results and for the laying of foundations upon which forecast of further development can reasonably be erected. The first and specially interesting fact is that women are better performers than men. That is to say, they learn more easily and operate with less purposeless expenditure of power. The faculty or gift in virtue of which they do this is the same as that through which they dance more gracefully than men, are apter at the lighter acrobatic feats and excel in all the rhythmic reflex movements of industry. The woman, moreover, has a keener enjoyment of the wheel, attributable to this same quality in her organization.

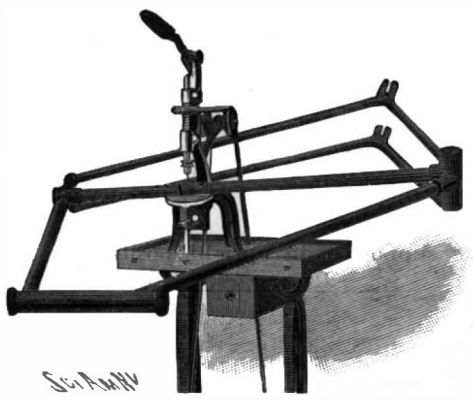
This kind of use of the wheel has nothing to do with the mere feats of endurance and muscular strength that are involved in competitions and contests. In those, men surpass women as they do in corresponding feats of athletics. Among the observed effects of the use of the wheel by women, Dr. Championniere observes a marked increase in the amount of muscle developed all over the trunk of the body, especially about the torso. The lung capacity increases in a notable way, and above all, the full, healthy action of the heart, which is usually deplorably impaired in the average woman in easy circumstances, is so completely restored as to leave nothing to be desired. The deposition of fat, which is described as the plague of the Frenchwoman's life, is averted. Not less marked is the change in the woman's carriage in walking.

The doctor asserts that he is able to detect infallibly the wheelwoman from her sisters when they cross streets. The one proceeds with self-confidence and ease when the other backs and dodges and loses her head and invites disaster. From this point of departure he proceeds to examine the mental discipline afforded by the bicycle, and thence deduces his most striking conclusions. He finds that the woman's powers of attention and observation are awakened in an extraordinary degree. Perhaps it would be more exact to say that these powers, with which all human beings are endowed at birth, are saved from the atrophy which in both sexes is one of the most marked defects produced by civilization.

The wheelwomen, he insists, become more graceful in every respect. The mincing, wriggling gait is lost among them. They move with more of the freedom and dignity often observed as native to some among the higher races that have not been deteriorated by the vices of pseudo civilization. The doctor is anxious to repel any suspicion that he is weaving theories, and to insist that his deductions are the fruit of actual and scientific, that is, exact observation. He took up the subject with an open mind, and sets down no more than he has seen with his eyes and learned from systematic notes of cases. At the close he permits himself, it is true, to dream of a French new woman, the product of the bicycle. It is not difficult to follow him with faith in his forecast, for his wheelwoman does not appear to be in anything different from the figure already made familiar to ourselves on the tennis court. —N. Y. Sun.

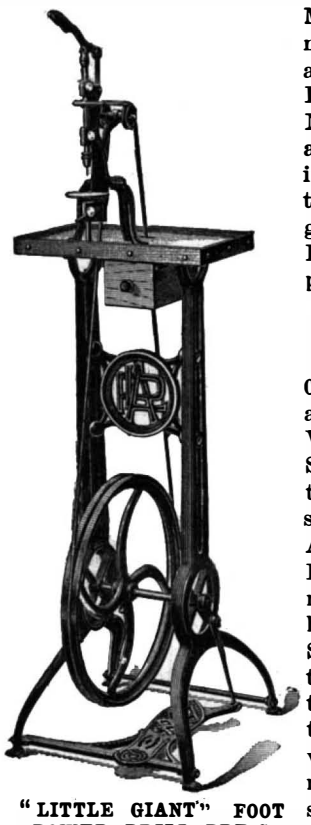
A DRILL PRESS FOR BICYCLE REPAIRING.

For neatly and quickly repairing a broken bicycle, the "Little Giant" foot power drill press shown here-



BICYCLE FRAME REPAIRING ON DRILL PRESS.

with affords the utmost facility. It is light and well made, and especially adapted for drilling small work where neither steam nor electric power are available. In one of the views the drill is represented at work on a bicycle frame, making holes for the rivets to be used in mending a broken portion of the frame. This drill is made by the Richards Manufacturing Company, manufacturers of novelties and specialties, No. 218 Fulton Street, Brooklyn, New York. It is fitted to a well made and strong iron frame, with wooden table and drawer and large grooved balance wheel. Its weight complete is fifty pounds.



"LITTLE GIANT" FOOT POWER DRILL PRESS.

Strength of Wood.

As a result of nearly 40,000 tests of timber made at the laboratory of the Washington University, of St. Louis, under the direction of the Forestry Division of the Department of Agriculture, says Railway Engineering and Mechanics, the following facts have been determined: Seasoned timber is about twice as strong as green timber, but well seasoned timber loses its strength with the absorption of moisture; timbers of large sections have equal strength per square inch with small ones when they are equally free from blemish; knots are as great a source of weakness in a column as in a beam; long-leafed pine is stronger than the average oak, and bleeding timber does not impair its qualities. It is stated that a large amount of chestnut felled in Alabama for the tan bark was allowed to rot because its value for railroad ties was not known. The Division of Forestry called attention to the superiority of this timber for ties, and the wood is now so utilized, with a saving to that region alone of nearly $50,000 per year.

Fencing With Newspapers.

Somebody says, "My children fence with rolled-up newspapers as foils, only a touch on the sword arm to count. They begin with some calmness, but in about a quarter of a minute they are whacking away at each other like good fellows, and a quarter of a minute later they are prancing all over the room and laughing uproariously. There seems to be more exercise and more fun in fencing with rolled up newspapers than in any other home amusement."

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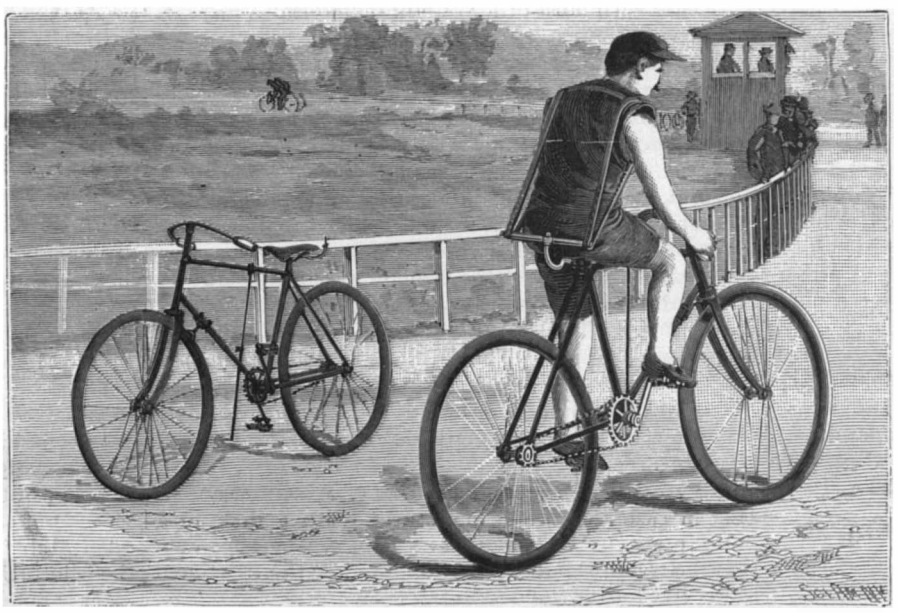
IMPROVEMENTS OF INTEREST TO BICYCLE RIDERS.

An improvement designed to enable the rider to propel his machine with increased power, by attaching to it a support affording a resistance above the shoulders, is shown in the accompanying illustration. It has been patented by Mr. Estanislao Caballero de los Olivos, of No. 34 West Fifteenth Street, New York City. To the rear of the saddle frame a curved rod is secured by a clip, the vertical outer portion of the rod having a collar on which rests a transverse bar to which are attached the straps of a shoulder brace. In the transverse bar is a spring-pressed slide, adapted to engage a notch in the vertical support, but by pressing upon a button on the outer end of a rod extending from the slide to one end of the bar the latter is disengaged from its support, freeing the brace from attachment to the machine and relieving the rider from its tension. As the straps afford a resistance or fulcrum above the shoulders of the rider, he is enabled, by means of the brace, to exert a considerably greater downward pressure with his feet. The straps preferably have pads, and yokes or other forms of support may be substituted for them, as may best accommodate the rider. Another improvement of the same inventor is also represented in the illustration, consisting of a light and simple form of stand by which the bicycle may be supported in upright position when not in use. It is a telescoping leg or rod whose upper end is attached to the top bar of the frame, the lower end of the bottom section, when extended, reaching the ground and forming a rest when the machine is tipped slightly to one side. When the sections are closed up, the lower end of the extensible leg is secured to the lower bar of the frame. On the lower bar is also a short spring arm, carrying a shoe, adapted to be sprung into engagement with and form a lock upon the tire of the front wheel when the machine is at rest, preventing the turning of the wheels.



CABALLERO'S BICYCLE SHOULDER BRACE AND BICYCLE STAND.

JAPANESE CLOCKS.

The Japanese are the only ones outside of western Europe who have constructed clocks having a peculiar character, and the manufacture of them dates from the end of the sixteenth or the beginning of the seventeenth century. Their first attempts were made after they had seen the European types that were brought to them, but they soon devised systems of dials and movements more in keeping with their method of counting the hours.

Among the various systems that are peculiar to them, let us describe that which we illustrate in Fig. 1. This piece, which dates from the beginning of this century, consists of a well-made wooden case, containing the clock, which is of gilded copper. The movement shows perfect workmanship and the back pillar plate is carefully decorated with fine engravings. The skill of the Japanese in matters of clockwork is indisputable, and the decoration of their clocks is often most charming. We shall explain the peculiarities of the dial of this clock and the manner in which the hours, days, days of the month and moons are counted.

In Japan, the civil day consists of twelve hours only, instead of twenty-four. There are six of the day and six of night. The six diurnal hours are counted from the rising to the setting of the sun, and the six nocturnal ones from its setting to its rising. So, the days and nights have equal hours twice a year only, that is to say, at the equinoxes, while at the solstices the disproportion is considerable. The division of the two periods, diurnal and nocturnal, usually of unequal length, requires that the six divisions that compose them shall themselves be unequal; hence hours of greater or less length. On the long days, for example, the six hours of the night are shorter than those of the day. Sometimes, therefore, it is the hours of the day that lengthen to the detriment of the night, and sometimes the contrary is the case, according to the time of the year.

This manner of dividing the year is not exclusively Japanese, for it was universally employed in antiquity. It is what is called the natural day, while our day, which is divided into equal parts, without regard to the rising or setting of the sun, is called the artificial day. But in Japan, the thing is strangely complicated when it is necessary to count the hours. It would seem that nothing was more simple than to count the twelve parts of the day from 1 to 12. Such simplicity has been disdained in Japan, and the process adopted is as follows: As nine is regarded as the perfect number, midnight and noon are called 9 o'clock. Thus noon will be 9 o'clock of the day and midnight 9 o'clock of the night, while the rising and setting of the sun are either 6 o'clock of the day or 6 o'clock of the night. If it be asked how nine can be found twice in twelve, we answer that the seeming arithmetical impossibility will be overcome if we begin to count by four, which will allow us to finish by the perfect number nine. The intermediate numbers are developed thus: Twice 9 is 18; suppress the decimal figure and eight remains; that is why the hour that follows noon or midnight, that is to say, the second hour, is 8 o'clock of the day or night. Three times 9 is 27; suppress the decimal as before, and there remains 7, which makes the third hour, and so on.

In order to mark these hours and obtain the equation of the days, the Japanese have employed various systems; sometimes that of the balance shown in the clock in Fig. 2, and sometimes that of the dial, as in Fig. 1.

In the first of these systems, the balance consists of a vertical rod upon which is horizontally mounted a strip of metal whose upper edge is notched and from which are suspended two small metallic weights that may be moved at will from or toward the axis in order to quicken or slacken the movement of it. In the long days, for example, the two weights are placed at the hour of sunrise at the extremity of the balance, and the hours are marked slowly. When the hour of sunset arrives, they are placed near the center of the axis and the hours of the night pass much more rapidly. There are thus obtained, by a proper regulation, the long hours for the long days and the short ones for night.

In the system of regulation by the circular dial, the latter consists of twelve sliding cards, upon which the hours are painted, and which are so mounted in the disk that they can be easily moved away from or toward each other. In the long days, for example, the six cards that serve to mark the diurnal hours are widely spaced, and the six that serve to mark the night hours are proportionally moved closer together.

The equation of the days is therefore operated by the proportionate spacing of the cards by hand. It is necessary to add that in this system the complete dial is revolved by the movement, and the hours present themselves successively before the hand, which is stationary. The six hours of the day and the six of the night constituting the complete day have a name as well as a figure. But the complete day, instead of being composed of two periods of six, comprises twelve names corresponding to the signs of their Zodiac. These are: The Rat for midnight or 9 o'clock. The Ox for 8 o'clock. The Tiger for 7 o'clock. The Rabbit for 6 o'clock. The Dragon for 5 o'clock. The Serpent for 4 o'clock. The Horse for noon or 9 o'clock. The Goat for 8 o'clock. The Monkey for 7 o'clock. The Cock for 6 o'clock. The Dog for 5 o'clock. The Boar for 4 o'clock.

We give a facsimile, Fig. 3, of these twelve subjects; but upon the clock dials that represent them they are figured only by characters answering to their names. The dial that we reproduce belongs to a system of clock other than the one of which we speak.

Each of the twelve hours is divided into ten parts.

The use of the twelve branches to designate the hours is borrowed from the Chinese, but the other combination for counting the six hours is, as has been said, peculiar to the Japanese.

Having spoken of the hours, we shall explain how the days of the month and moons are indicated. In two small apertures situated beneath the dial (Fig. 4) appear Japanese characters. In one, that to the left, are the signs of the Zodiac. They represent the days to the number of twelve, which are the same as those of the hours, and so in Japan one may be at the same time at the hour of the Cock, the day of the Cock, the month of the Cock and even the year of the Cock.

To the right is the month represented by one of the ten elements. In order to obtain the day of the moon (for the year is lunar, and not solar, as with us), the twelve signs

Fig. 1.—PORTABLE JAPANESE CLOCK.

Fig. 2.—JAPANESE CLOCK WITH WEIGHTED BALANCE.

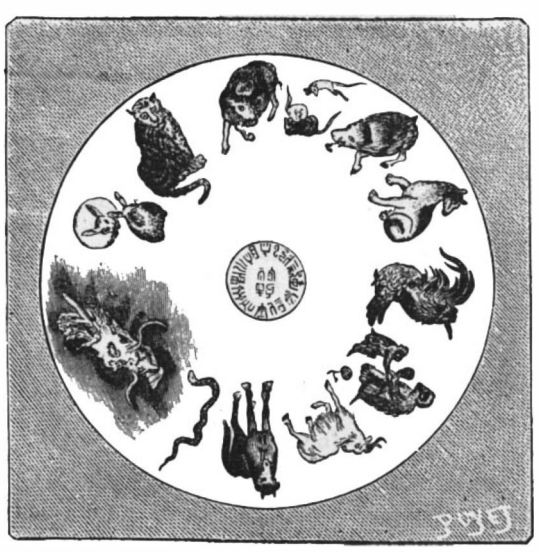


Fig. 3.—JAPANESE CLOCK DIAL OF PORCELAIN.

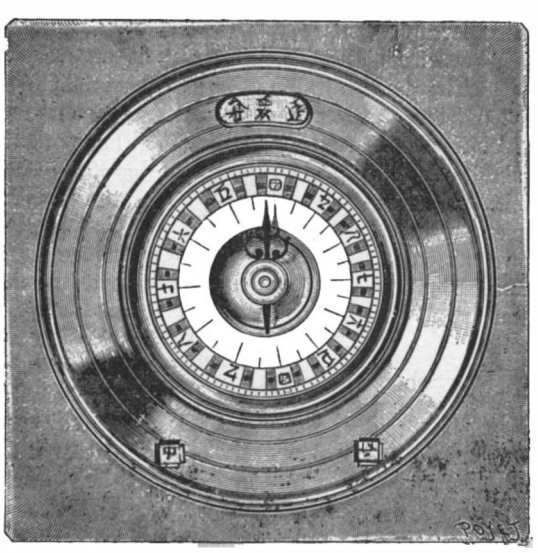


Fig. 4.—JAPANESE CLOCK DIAL OF COPPER.

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of the Zodiac are combined with the five elements, which are wood, fire, earth, metal and water. These are doubled by regarding them in two different states, to wit: first, in their natural state and then as adapted to the use of man. Thus, wood in its natural state as a tree is the first element, which becomes the second when cut down and converted into timber. Fire, the third element in its original state, as solar light, etc., becomes the fourth element lighted by man with wood, oil, etc. Earth, the fifth element in its uncultivated state upon mountain tops or at the bottom of the sea, constitutes the sixth element when it is worked by the hand of man and changed into porcelain, pottery, etc. Metal, which is the seventh, considered as an ore, becomes the eighth when molten, worked and converted into tools. Water forms the ninth element, such as it falls from springs and flows into rivers. It is the tenth when stagnant in ponds or escaping from a reservoir.

In order to know what day it is, we consult one of the two apertures, that to the left. A wheel, actuated by the movement, revolves by one tooth, which forces the dial upon which the signs are engraved to present a new one. The number of the teeth is twelve, corresponding to the twelve signs.

The day of the month is indicated in the aperture to the right in the same way by a character which is that of one of the ten elements that we have enumerated above. The wheel that causes them to operate has ten teeth which gear with the wheel of the twelve days. The ratio of these two wheels in their revolution is such that every sixty days only the same signs return in concordance as at their starting point, this corresponding to two moons.

It is by combining the relation of the two signs in presence that we obtain the day of the month. Let us, for example, take the sign of the Rat, visible in one of the apertures, and Wood, first state. In the other we shall have the first day of the moon. The next day we shall have the Ox in presence of the Wood, second state, and so on until the eleventh day, in which we find the Dog in presence of the Wood, first state, and the next or twelfth day, the Boar with the Wood, second state. On the thirteenth day the Rat returns to present itself with the Fire, first state, and so on up to sixty.

In the top aperture is indicated the fortnight or half moon marked by twenty-four signs that present themselves in succession. The wheelwork of the movement actuates the wheel that carries them, and this wheel makes its revolution in a year of three hundred and sixty days. A distinction is made between the first and second fortnight of the moon.

These three indications, of which we have just spoken, permitted, when they were united, of knowing what was the day, the day of the month and the fortnight of the year. It was, upon the whole, what in another manner was marked and is still marked by certain of our European clocks. We should add that since 1872 the Japanese have been employing our method of counting and marking the hours.—La Nature.

Irone.

In the alcoholic extract of orris root the inventor has discovered a new substance, which is the aromatic principle of the root, which he gives the name "irone." It is a ketone, having the formula $C_{13}H_{20}O$. This body has the characteristic odor and flavor of the orris root, and may be preferentially employed in perfumery, etc. Its preparation is carried out thus: The alcoholic or ethereal extract of the root is distilled in a current of steam. Organic acids, ethers, alcohols, and irone pass over into the distillate, which is then treated with ether and the ethereal solution agitated with a dilute alkali solution, in order to separate the free acids. The mixture is evaporated down and the residue dissolved in alcohol, which solution is mixed at the ordinary temperature with a weak solution of an alkaline hydrate in order to saponify the ethers of the organic acids. After some minutes it is poured into water, the neutral oils are dissolved in ether, the ether is evaporated, and the residue distilled in a current of steam. Irone is one of the bodies distilling over first, and by repeating this operation several times it may be obtained fairly pure, but still containing small quantities of aldehydes, which are eliminated by treatment with weak oxidizing agents. The irone is then converted into its phenylhydrazone or condensed with another substituted ammonia to a ketone, from which bodies it is obtained by decomposing with dilute acids and distilling.

Irone boils at 144° C. under a pressure of 16 mm. and has a specific gravity of 0·939.—J. C. W. F. Tiemann, Berlin.

MOST medical men consider that a cold bath every morning is apt to do more harm than good to any but persons of a very vigorous constitution. The sensible thing to do is to see that the temperature of the water in cold weather is not lower than that of the air. A daily bath is a most healthful practice; but it should not be so cold as to give a shock to the system.

Limes and Cements.

A very interesting and valuable monograph is that entitled "Portland Cement," by Charles D. Jameson, professor of engineering, State University of Iowa. It contains, within a comparatively small compass, a large amount of information of the precise authentic kind the engineer, builder, director, or owner of buildings or masonry works ought to know. First is presented certain general considerations, showing that while lime and cement enter into almost every form of engineering construction, their ultimate value depends more upon the manner in which they are used than is the case with most other building materials. Says our author:

"Take wood, stone, or iron, for example. Provided a good quality has been selected, nothing the constructor can do will materially affect this quality. The material may be used injudiciously and uneconomically, but the ultimate strength remains the same. A square inch of steel will stand about the same tensile strain under all circumstances. With limes and cements, however, this is not the case. No matter how perfect the original quality of the cement may be, it may become absolutely worthless and a source of danger, if not properly handled and applied after being received.

"This fact makes it of the utmost importance that, at least, all engineers should be familiar with the manufacture, use, and methods of testing limes and cements.

"The engineer should be able to recognize a good cement when he gets it, and if it is not good, to indicate the probable reason of its failure, whether in the raw material, the method of making, or the treatment it received after the making.

"Both lime and cement, when used for building purposes, are mixed with a certain amount of water and used in a more or less plastic condition. While in this plastic condition they are placed in the work in whatever position or form is required and then this mixture hardens with more or less rapidity.

"This hardening is called setting, and it is this property of setting under different conditions that forms one of the radical differences between limes and cements.

"Lime mortar will only set when exposed to the action of the air, and therefore can only be used in layers so thin that the air can penetrate to all parts of it. All parts of this lime mortar must not only be accessible to the air, but to insure setting, the air must be dry.

"Where lime mortar has been used in cellars that are damp and in the plastering of houses exposed to the damp sea winds its absorption of moisture has been so great that it never has become thoroughly set, and is always more or less damp and soft. With cement and cement mortar this is not the case.

"A mixture of cement and water, properly made, will not only set in the open air, but will set when immersed in water or when in a vacuum. That is, contact with the air is not necessary, in order that the process of setting may take place. In fact, not only is contact with the air not necessary for the setting of cement, but in order that the maximum results may be reached, all cement mortar should be kept either wet or immersed until it has become thoroughly set.

"This may be considered as one of the most important rules governing the use of cement, viz.:

"The quality of any cement work is very materially improved by keeping it wet during the process of setting. From this fact, that contact with the air is not necessary for the proper setting of cement, it is evident that there is almost no limit to the mass of cement mortar or concrete that can be used. No matter how massive the structure may be, and no matter in what thickness the cement mortar or concrete may have been used, if the proper materials have been properly manipulated, this mass will set thoroughly throughout. Therefore, while lime can only be used in a dry location and in thin layers, cement can be used in any location and in any quantities.

"Lime mortar under the best of circumstances has very little strength, either of adhesion or cohesion, while the best Portland cements properly used attain a strength superior to that of any of the building stones, with the exception of some granites, quartzites, and trap.

"The general differences between limes and cements, from an engineering standpoint, may be taken as lying in the fact that limes will set only in contact with dry air, while for the setting of cement, not only is the presence of dry air not necessary, but the best results obtain when the cement is kept wet or immersed in water.

"There can be no sharp line drawn between limes and cements, although there is no difficulty in distinguishing at sight between pure lime and good cements.

"The ordinary lime of commerce consists of the calcined carbonate of lime in a state of greater or less purity.

"The constituents of cement are carbonate of lime, silica, and alumina with iron, with a few other ingredients of more or less importance. These three, carbonate of lime, silica, and alumina, with iron, however, are the most important, and are always present in varying proportions. It is the relative proportions in which these constituents are mixed that make the resulting cement more or less hydraulic, that is, the power of setting under water, as the hydraulicity of the resulting compound varies as the percentage of the ingredients vary. We have cementing compounds from pure lime at one end of the list to Portland cement at the other. They can be divided into the following three classes: Lime, hydraulic lime, and cement.

"Lime consists of practically pure carbonate of lime with less than 10 per cent of impurities.

"Hydraulic lime has mixed with the lime from 10 to 25 per cent of silica, alumina and iron.

"Cement contains:

Lime	55 to 65 per cent.
Silica	18 to 24 "
Alumina and iron	8 to 14 "

"These usually amount to 94 or 96 per cent of the whole. The balance may be made of magnesia, alkalies and sulphuric anhydride. These last are present in minute quantities, and although they undoubtedly have some influence upon the qualities of the cement, still this effect is very slight.

"Lime.—Lime is made by the simple calcination of more or less pure carbonate of lime. This is found as limestone in all parts of the world. The calcination is done usually in a kiln. The fuel most commonly used is wood, but either soft coal or coke may be used. The method of charging the kiln is as follows: A rough, open arch is built of limestone above the bottom of the kiln. Upon this is placed a layer of fuel, then a layer of limestone, a layer of fuel, and so on, alternately, to the top of the kiln. The layers of fuel grow less as the top is approached. The fire is started at the bottom and the temperature gradually increases. As the fuel is consumed the limestone drops toward the bottom, and more fuel and limestone is added at the top. As rapidly as the limestone becomes sufficiently burned it is removed from the bottom of the kiln. It comes from the kiln in hard, white, rock-like pieces.

"One peculiarity of the freshly burned lime is the great avidity it has for water, and, when it is exposed to moisture, the great amount of carbon it will absorb.

"Lime that has not been exposed to moisture, and is in more or less the same condition in which it came from the kiln, is called quicklime. When this lime has been exposed to moisture in any shape, and allowed to absorb as much as possible, it is called slaked lime.

"All lime, before being used, must be slaked. This can be done by drowning, sprinkling, or exposure to the air.

"Drowning.—The quicklime is spread out in a watertight box and water added until it is completely covered. The entire amount of water needed should be put in at once. When the water is added the temperature rises, the mass effervesces, the quicklime increases rapidly in bulk, slowly disintegrates, and finally falls to pieces in a fine white powder, soluble in water. The impurities are separated from the lime. If additional water is added after the process of slaking has commenced the temperature is lowered and the slaking is not done as thoroughly as it otherwise would be. After the water has been added it is a good plan to cover the box so as to retain the heat as much as possible.

"The increase in bulk due to slaking is 200 or 300 per cent. The lime, after the slaking is complete, is run off through an opening in one end of the box. It is about the consistency of very thick cream. The opening is covered with a grating or netting to prevent the passage of hard lumps, etc. The slaked lime is run either into another box or into an excavation in the ground, this second box or excavation being many times larger than the slaking box. The slaked lime soon becomes a stiff paste, and should be covered with sand or boards. It should not be used for mortar for a number of days, usually about ten, until it has become thoroughly cool.

"Slaking by Sprinkling.—The quicklime is spread out in a layer 6 or 8 inches in thickness, and thoroughly sprinkled with water. It slowly disintegrates and falls into powder. There is no great increase in the temperature, and no effervescence takes place. One drawback to this method is the space and time required, which are both much greater than is required for drowning, and there is no reliable data to show that the lime thus slaked is in any way improved.

"Air Slaking.—The lime is spread in layers 4 to 6 inches thick, and exposed to the air. It must be turned a number of times in order to insure thorough exposure to the air. The time and space required are both very great and the gain, if any, small. Thoroughly slaked lime paste can be put up in airtight casks and kept without deteriorating for almost any length of time.

"Hydraulic lime is made by the simple calcination of limestone that contains anywhere from 10 to 25 per cent of the requisite impurities. The temperature required for calcination is but slightly higher than that needed for the burning of quicklime. The material

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must be slaked the same as quicklime before it can be used, and is reduced to powder in this way. No grinding machinery for reduction is used. The slaking is much slower than is the case with quicklime, and as the proportion of impurities increases it becomes slower and slower, until at last a point is reached where the resulting substance passes from hydraulic lime to natural cement. The reduction must be done by grinding and the hydraulicity becomes a prominent characteristic.

"Cement.—Cement as used in an engineering sense means such a combination of lime, silica, alumina and iron, that when properly calcined, reduced to powder, and gaged with a proper amount of water, has the property of setting under water and in places where it is not exposed to the action of the air. It also has the property of setting when in contact with the air.

"For good results to obtain, the proportion of the requisite constituents must be within certain narrow and well-defined limits. These proportions have already been given.

"The cements used in building construction can be divided into two general classes, natural cement and artificial or Portland cements.

"The term Portland cement means an artificial cement as distinguished from natural cement.

"Natural Cements.—In many parts of this country and Europe there have been found immense deposits of impure limestone, that contain with more or less accuracy the necessary constituents for the making of cement. These constituents have been mixed by nature and for cement making must be used in the proportions found.

"The difference between the natural and Portland cements as to the raw materials used is this:

"The desirable constituents in each are the same.

"In making natural cements, some impure limestone that contains as nearly as may be the correct proportions of lime, silica, and alumina is used, and the value of the resulting cement depends upon the correctness with which nature has mixed these ingredients. It is found good, bad, and indifferent.

"With the raw material for Portland cement, however, nothing is left to chance. It is known, within certain narrow limits, what the constituents should be and in what proportions they should be present. This being known, such materials are used as contain these constituents in a more or less pure state, and then these comparatively pure raw materials are mechanically mixed in the correct proportions.

"The mere fact that the raw materials are nearly perfect does not insure good cement, as the best of raw material may be rendered useless by improper burning or grinding. But, on the other hand, no good cement is possible unless the raw materials are good. Of course any mechanical mixture of lime, silica, alumina, etc., within the limits named, will give good Portland cement if properly burned and ground. But in selecting raw material there is one other, most important, question that must be considered, viz., that of cost.

"In order to make a perfect mechanical mixture the materials must be reduced to an impalpable powder. The harder the materials, the more expensive this is; consequently, in selecting the raw material, the question of the cost of reduction must be considered.

"The advantages of Portland cement over natural cement are two, viz.:

"1st. The Portland cement is much better per se. The best natural cement never attains the hardness nor has the strength or durability of the most ordinary Portland.

"2d. Where proper care is used, Portland cement of any one brand possesses a uniformity of quality that can never be attained in the making of natural cement.

"Examine almost any stone quarry, and the impossibility of obtaining a uniform quality of stone in any quantity will be seen at once. The quality of the stone varies in different parts of the quarry and in different layers of the stone, no two layers containing the same chemical constituents. As the stone is used in the condition in which it comes from the quarry, it will be seen that there will be an unavoidable variation in the quality of the resulting cements.

"With Portland cement this is different. The raw materials are practically pure, and after experiments have given the proportions of mixing and the subsequent methods of treatment, there is no excuse for any irregularity in the results.

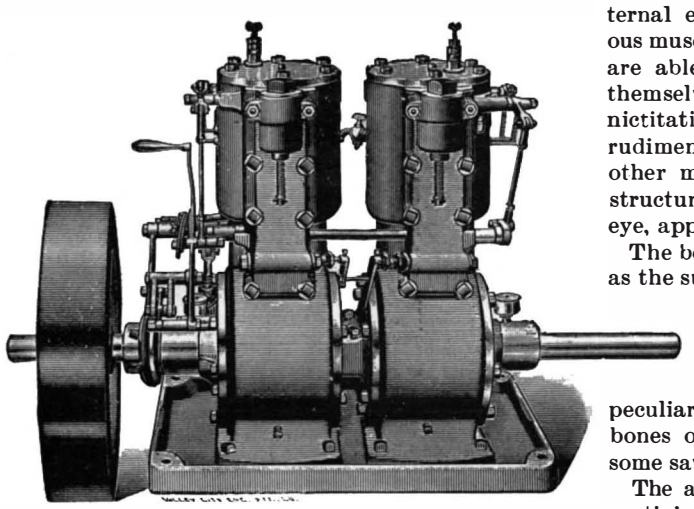
"This uniformity in results is the one great point to be worked for in cement making. It can only be accomplished by the exercise of the greatest care in the selection and treatment of the raw materials. In the process of making there are some radical differences between natural and Portland cements. In the calcination the natural cements require a temperature but little above that required for lime burning, while the Portland cements require a temperature just short of that required for vitrification. The mixing, grinding, etc., all increase the cost of the Portland until at last the finished product brings about $3 per barrel on the market, while the natural cement sells for 50 cents.

"True economy in the choice of cements consists in using the one best adapted for the work in hand. When the work is such as to justify the increased expense on account of required durability or strength, then the best Portlands should be used. But on less important work or masonry of a cheaper character, the natural cements should be used. Nothing has done more to improve the character of all masonry work during the last twenty-five years than the cheapness and excellency of these light-burned natural cements."

The author then presents interesting historical data relating to the uses and manufacture of cements, the processes relating thereto, the machinery employed, the various tests of cement, abstracts from specifications, directions for using cements in various kinds of works, making of concrete for roads and foundations, cement sidewalks and pavements, etc. The practical information contained in this work is of rare value.

A NEW GASOLINE MOTOR FOR BOATS AND LAUNCHES.

A motor which can be started without turning the fly wheel by hand, by simply using the reverse lever, and which may be handled the same as a steam engine, without requiring a boiler, feed pump, etc., is shown in the accompanying illustration. It has been recently brought out at the Wolverine Motor Works, Grand Rapids, Mich. These motors are perfectly balanced, the cranks being directly opposite each other, and one going down as the other goes up, permitting them to be run at a very high speed without jarring the boat. There is no gearing on the engine or propeller shaft to make a noise, and the engine can be reversed by simply moving one lever. It is free from any possibility of fire or explosion, requires no licensed engineer or pilot, and can be operated by any one, man or woman, after an hour's instruction, or from the printed directions. It can be run slow or fast by the use of the throttle lever. Preferably the common solid propeller wheel is employed, made in one piece, rigidly connected to the propeller shaft, the latter being rigidly connected to the crank shaft of the motor.



WOLVERINE DOUBLE CYLINDER MARINE MOTOR.

It is claimed that this motor is not only one of the simplest to operate, but that it embodies more valuable features than it has heretofore been considered possible to combine in a gas engine.

Some Vestigial Structures in Man.

BY W. E. ROTZELL, M.D., NARBERTH, PA.

The term vestigial is used in anatomy as being more convenient in describing those parts generally known as rudimentary, abortive, atrophied, or useless. There are many vestigial structures in man, and an attempt to more than mention some of the most interesting of them would far exceed the limits of this article.

The appendix vermiformis is a vestigial structure, and, like all such structures, has no function to perform in the organism. "Not only is it useless," says Darwin (Descent of Man, New York, page 21), "but it is sometimes the cause of death."

The vermiform appendix is, doubtless, the remains of the much elongated caecum that is found in the majority of the herbivorous mammals. The usefulness of the tonsils is also doubtful. They are, as we all know, frequently the seat of disease, and after removal the individual realizes no inconvenience from the loss. Of what utility are the cervical auricles that occasionally occur in man, or the supernumerary legs, fingers, and toes, as well as all the other abnormalities that frequently occur?

Among the lower animals there are numerous instances of useless organs, such as the clavicle of the cat, the teeth of a whale, or the sting of a bee or wasp, which when used, as a rule, causes the death of its owner. Referring to insects, Professor Graber (Die Insecten, Munich) says: "There are also numerous structures and organs which may, with absolute certainty, be pointed to as perfectly useless." "But seeing that so enormous a number of specific peculiarities are in the same predicament, it surely becomes the reverse of reasonable so to pin our faith to natural selection as to conclude that all these peculiarities must be useful, whether or not we can perceive their utility. For by doing this we are but reasoning in a circle. The only evidence we have of natural selection is furnished by the observed utility of innumerable structures and instincts which, for the most part, are generic, family, or higher order of taxonomic value. Therefore, unless we reason in a circle, it is not competent to argue that the apparently useless structures and instincts of specific value are due to some kind of utility which we are unable to perceive."

The third molars, or wisdom teeth, are becoming vestigial in civilized man. These teeth are now, as a rule, the last to come and the first to disappear; they are smaller and more variable than the other molars and have only two separate fangs.

The body of adult man is always more or less covered with hair; this hair is the remains of the more extensive hairy covering possessed by his ancestors. An interesting fact in relation to this hairy covering is that the hair on the arm and forearm is directed toward the elbow—a characteristic which occurs only in the anthropoid apes and the American monkeys. The explanation of this has been given by Wallace (Natural Selection and Tropical Nature, London, page 194), who states that the orang, when resting, holds its long arms upward over its head, so that the rain flows down both the arm and forearm to the long hair which meets at the elbow. In accordance with this principle, the hair is always longer or more dense along the spine, often rising into a crest of hair or bristles on the ridge of the back. In the entire series of the mammalia, from the monotremata to the quadrumana, this character is very prominent.

It is a well known fact in embryology, that at about the sixth month the human fœtus is frequently covered with rather long dark hair over the entire body, except the soles of the feet and the palms of the hands. This covering of hair is shed before birth, and so it is apparently useless except as being an evidence of evolution.

Other vestigial structures are the muscles of the external ear, and the panniculus carnosis, subcutaneous muscles by which a large number of the mammalia are able to freely move their skin, thus protecting themselves from insects. The plica semilunaris, or nictitating membrane, the semitransparent eyelid, is rudimentary in man and other mammals, while in the other members of the vertebrata the function of this structure is to sweep over the external surface of the eye, apparently to keep the surface clear.

The bones of man present such vestigial peculiarities as the supracondyloid foramen, which occasionally occurs; it is normal in the lower qnadrumana. There is also the intercondyloid foramen, which occurs in man and the anthropoid apes, but is not constant in either. These peculiarities are found to be more common in the bones of the ancient races of mankind, and also in some savage races.

The anatomy of man presents a large number of vestigial structures, each of which throws some light on the long line of his ancestral history, and that can only be accounted for as explained by evolution.—Abstracts from the Hahnemannian Monthly.

Fish and Game Laws.

Here is a summary of the law of New York State relative thereto, as revised and amended by the last legislature:

Fish.—Polluting streams or taking fish by drawing off water or by dynamite, or taken from a stream to stock a private pond or stream prohibited. No fishing through the ice in waters inhabited by trout or salmon.

Trout.—Open season from April 16 to August 31, with 6 inch limit.

Salmon, Trout, and Landlocked Salmon.—Open season from May 1 to September 30.

Bass.—Open season from May 30 to December 31. Bass 8 inch limit.

Pickerel, Pike and Wall-eyed Pike.—Shall not be fished for, caught, killed or possessed, except from May 1 to January 31, except as provided in section 141 of the game laws.

Deer.—Open season August 16 to October 31. Limit, two deer to each person.

Squirrels, Hares, and Rabbits.—Open season from September 1 to November 30. Ferrets prohibited.

Birds and Wild Fowl.—Web-footed wild fowl, open season from September 1 to April 30. Quail, open season November and December. Woodcock and grouse, open season from August 16 to December 31. Plover, snipe, and English snipe shall not be shot or possessed during May, June, July, or August. Snaring, netting, or trapping of game birds prohibited.

As to private parks or grounds, the law is not changed from last year.

Dealers may have game or birds in possession out of season provided that they can show the same was shipped to them from a point over 300 miles from the borders of this State.

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GRAND SALOON OF THE STEAMER ST. LOUIS.

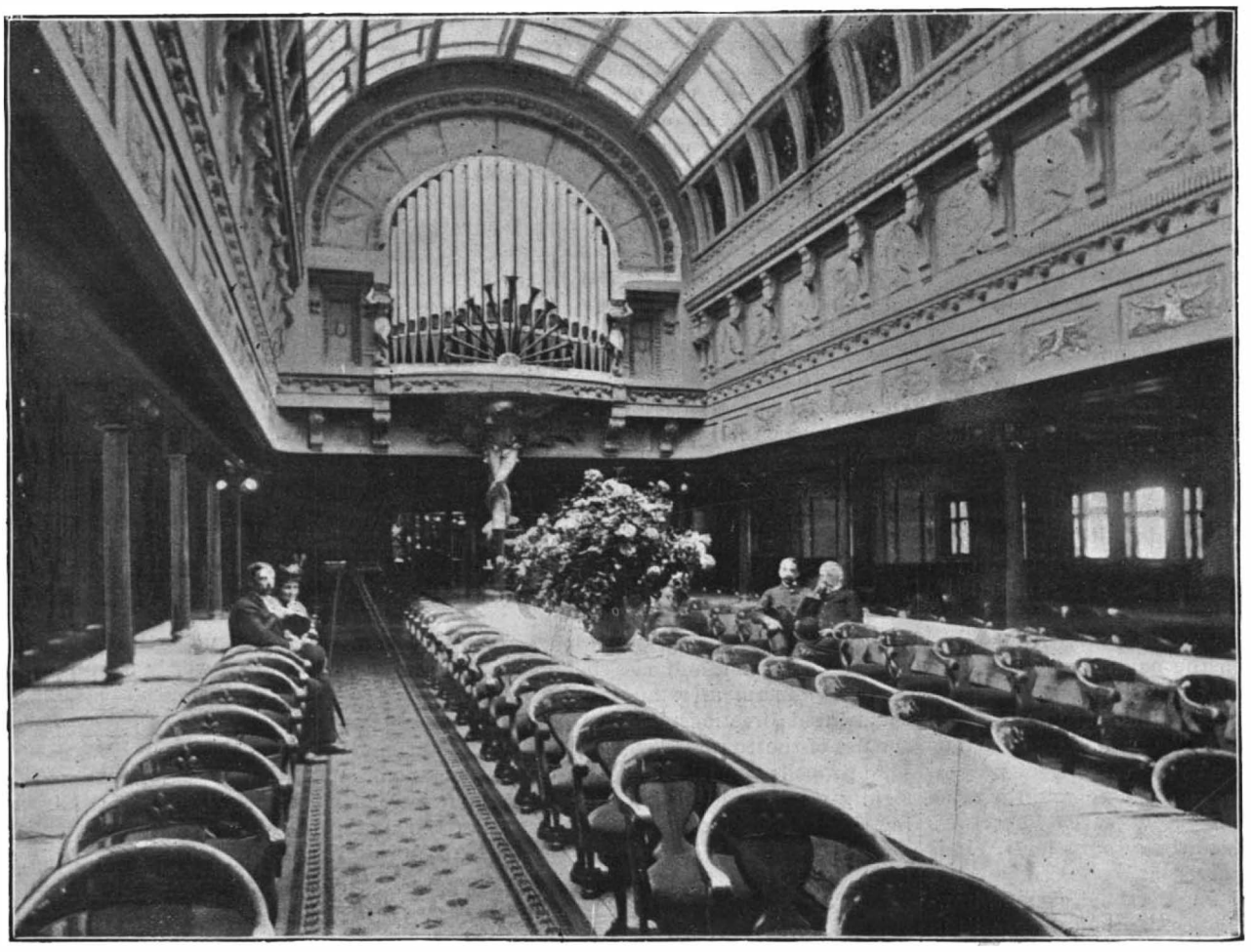
In our last number we gave a photographic representation of the new steamer St. Louis, as she appeared when steaming through the harbor of New York. Her arrival at Southampton is to be the occasion of public demonstrations, as the harbinger of increasing commerce between the old and new world. We present herewith a photographic interior view of the grand saloon of the ship, specially taken for the SCIENTIFIC AMERICAN. Probably no passenger vessel in the world can boast of a more elegant or spacious apartment. It is 110 feet long and 50 feet wide, surmounted by a beautiful dome, steel framed, set with ornamental glass, through which a flood of light illuminates every part of the saloon. Here are located the dining tables, and so generous are the accommodations that the entire corps of first cabin passengers, 350 in number, can be seated at one time.

The saloon is situated in the middle of the ship, so there is a comparative absence of motion. Slender, graceful columns support the dome. Nearly all the available space in the saloon not occupied by woodwork is filled with paneling. The dome contains on the after end two allegorical panels, broken by a separate seated figure of Neptune. At the base of the dome, on the two sides, there is a series of small panels which repeat figures of harp and viol players. At the forward end of the dome is a splendid pipe organ, which is actuated by electricity, both as regards the key mechanism and the blower. The base of the organ rests upon the shoulders of a mermaid. The organ was built by Jardine & Company, of New York. The walls of the saloon are broken into alcoves, which are filled with fish, fowl, and flesh panels. The prevailing wood is Mexican mahogany, and the upholstery is done in a bluish-green plush.

The drawing room and the social hall are equally effective, the drawing room having silk tapestry and silk paneled walls. The tone of the room is yellow. The library is one of the most charming rooms on the steamer, the prevailing color being sepia. The citizens of St. Louis presented the vessel with a noble collection of books, representing the most famous authors. The smoking room has a very rich effect, the woodwork being dark mahogany and the upholstery being in leather. The decorations refer to the Bacchic origin of wine and the Indian origin of tobacco. The staterooms are all handsomely decorated, and have air-filled mattresses, intended to serve as life-preservers in time of need.

The general scheme of decoration was designed by Messrs. Furness & Evans, architects, and was executed by the American Line under the immediate direction of Mr. Furness.

It is expected that the sister ship St. Paul will be ready to sail in September.



GRAND SALOON OF THE STEAMER ST. LOUIS.

THE pepsin sold in chemists' shops is prepared from the gastric juice of the hog's stomach.

A New Insulator.

M. Gentzch prepares an electric insulating material in the following manner: He heats resinous substances, such as ozokerite, amber and asphalt, in a retort, at a temperature of 400° C., until the condensable or gaseous volatile products are liberated. The result is a black residue, having, when cold, the consistency of wax or dry resin, and capable of being used either alone or in conjunction with gutta percha, other resins, mineral powders or with sulphur, as a cable insulator. The material, it is said, has sufficient plasticity to lend itself readily to the turnings and twistings to which the wires of cables are generally subjected. The proportions of the raw substances used should be preferably ozokerite, 50 parts; yellow amber, 45 parts; and asphalt, 5 parts.

THE DIAMETER OF NEPTUNE.—With the Lick telescope and an eyepiece magnifying 1,000 diameters, Prof. Barnard finds the mean angular diameter of Neptune, when reduced to the mean distance from sun 30·0551, to be 2·433". This corresponds to an actual diameter of 32,900 miles, which is from two to four thousand miles less than that stated in most of our text books.—Astronomical Journal, No. 342.

TORPEDO BOAT FOR THE WAR SHIP MAINE.

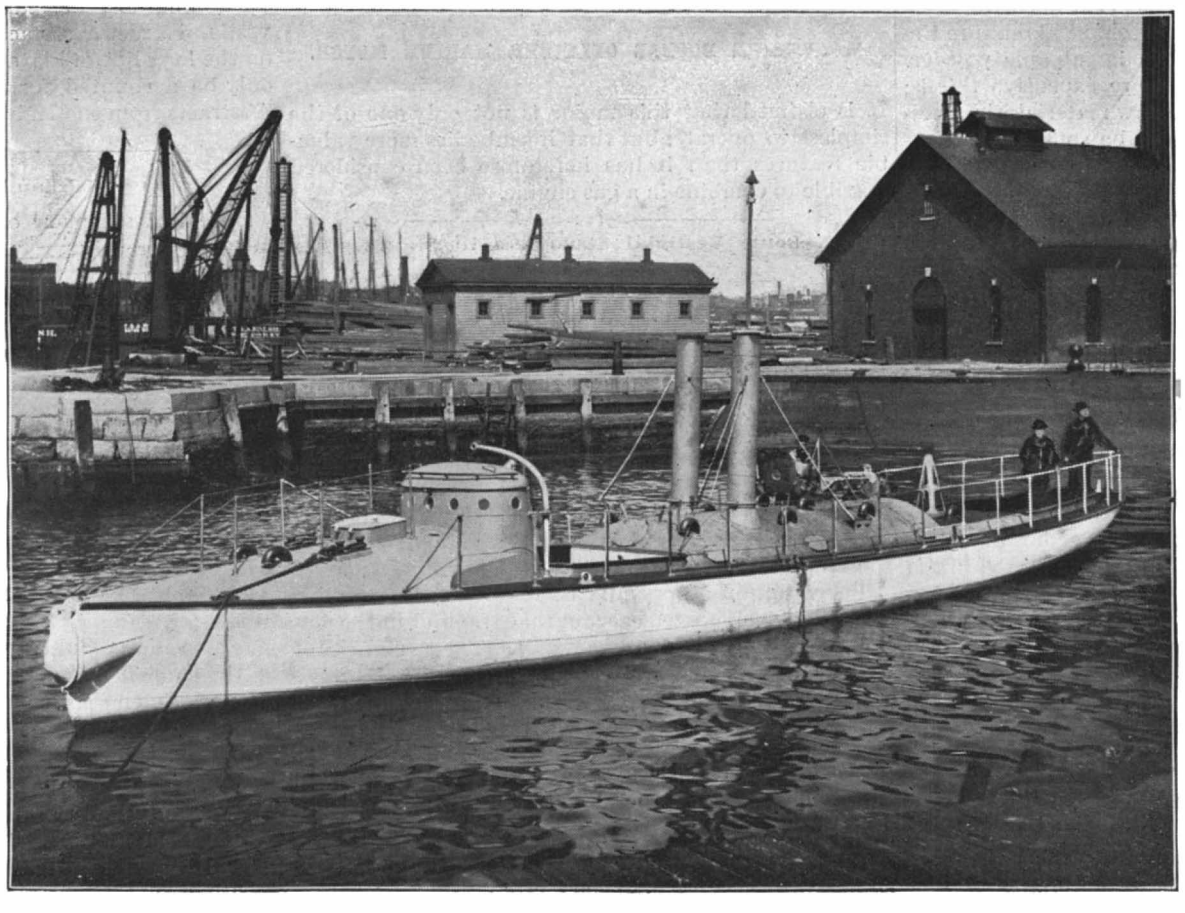
The recent war between China and Japan has shown the great value of the torpedo boat. English naval constructors and shipbuilders are now devoting their energies to the designing of other boats to destroy torpedo boats. The defense which the small torpedo boats can make is small when pursued or compelled to fight, but what Mr. J. I. Thornycroft says of torpedo boat destroyers is also true of torpedo boats: "The real protection of the vessel is its speed, which enables it to reduce within a very short period the time it is under fire."

The United States navy is deficient in the matter of torpedo boats, so that the coming test of one of the torpedo boats of the cruiser Maine will be looked forward to with interest.

We illustrated the construction of these boats in our issue of January 5, 1895, and we now give a view of one of them which has recently been completed, lying off one of the docks at the New York Navy Yard. It is hoped that the speed will be about 18 knots per hour.

The weight of the vessel without water in the boilers is 28,450 pounds. The torpedo boats for the Maine are technically of the third class. The boats are built as light as possible, so that they can be easily hoisted on board the large vessels. The torpedo boats will be operated entirely from the men-of-war as regards supplies, only a ton of coal at most being carried. The general dimensions of the boats are as follows: Length over all, 61 ft. 8 in.; length on load water line, 58 ft. 6 in.; beam at water line, 9 ft. 1½ in.; freeboard, 2 ft. 5 in.; mean draught, 2 ft. 2 in.; extreme draught, 3 ft. 4 in. Six watertight transverse bulkheads give seven watertight compartments. The general disposition of parts includes an open cockpit aft. Into this the rudder head enters, so that the boat can be steered from this cockpit if the conning tower has to be deserted. Forward of the cockpit comes the engine room, with a quadruple expansion engine. Forward of the engine comes the boiler room arranged for forced draught by the closed fire room system. The boilers are the Mosher tubulous boiler. Next to the boiler room comes another open cockpit, forward of which is the conning tower, which contains a steering wheel mounted on a half bulkhead. In the bows is placed the torpedo tube for discharging a Whitehead torpedo. In the extreme bow and also under the stern cockpit are trimming tanks. On deck aft is to be mounted a one-pounder rapid-firing gun, whose ammunition is carried in a magazine just aft of the engine room.

Along each side of the boat are coal bunkers, which, as far as their diminutive size permits, may be considered protective. Four heavy eyes are riveted to the sides along the waist, by which the boat is to be hoisted bodily out of the water. The mast of the Maine carries a large steel boom, from whose end the tackle for hoisting the torpedo boats will be worked, the boats being taken in on deck by a steam winch. Cradles are to be provided



TORPEDO BOAT FOR THE WAR SHIP MAINE.

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for them to rest in. The torpedoes will be carried by the Maine, the torpedo boat being able to carry only a single one at a time, which will rest in her tube. The role of action will simply be to get under way with the torpedo ready, then to approach the enemy as close as possible, to discharge the torpedo and run. Her side plates in places are but $\frac{3}{32}$ of an inch thick, so that she will be practically unprotected.

The crew includes the commander, engineer, firemen and two sailors. The Whitehead torpedo, which is used, weighs rather more than 2,100 pounds, so that stability as well as a measure of protection to the machinery is secured by placing the weights as low as possible. Thus the engine cranks in their stroke work down between the frames almost to the bottom of the vessel.

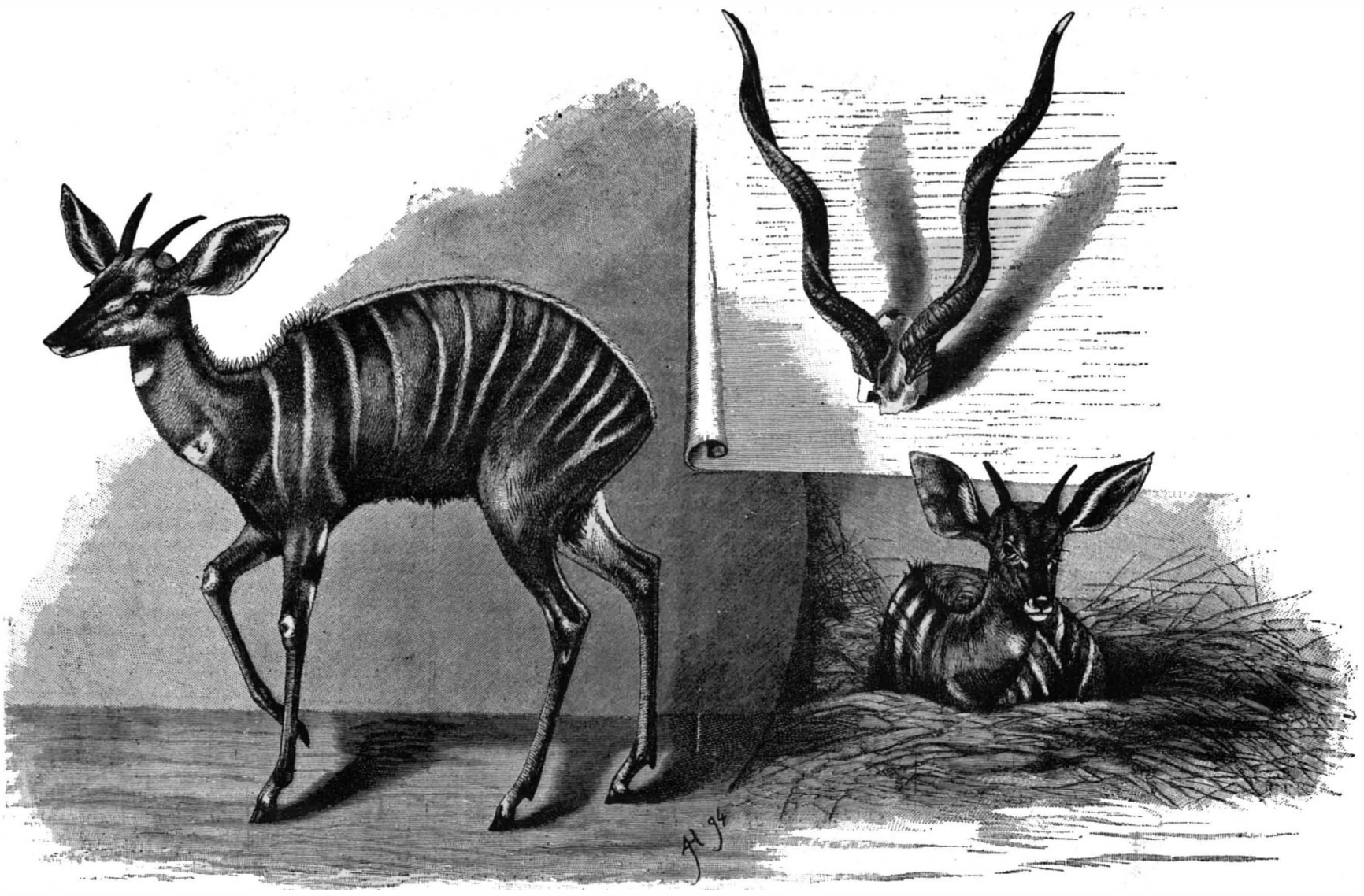
The results of calculations for stability are as follows: At nominal condition, ready for service, with ammunition, torpedo and crew of five men on board:

Metacentric height (feet)	1·55
Angle of heel at maximum stability (degrees)	43
Righting moment at maximum stability (ft. lb.)	27,135
Angle of vanishing stability (degrees)	89

In peace the boats will be used as dispatch boats, and will be undoubtedly very serviceable.

THE LITTLE KOODOO ANTELOPE IN THE BERLIN ZOOLOGICAL GARDEN.

Since the closing of the Soudan by the marauding excursions of the Mahdists, the trade in the exportation of African animals has suffered greatly, so that living giraffes are now counted among the most costly rarities in zoological gardens; but recently Mr. Menges, the dealer in animals, penetrated into that almost unknown region, Somauli, under the guidance of a native hunter. His discoveries tend to show that there is a marked difference between the animals of this region and those of the other parts of the Dark Continent. This difference is illustrated by our engraving, which shows a dwarf of the beautiful Koodoo antelope, which were so numerous on the steppes of Eastern Africa before the invasion of the devastating murrain. The little Koodoo antelopes differ from the larger species in the coloring of the body, which is grayer, with more light bands, and in the absence of the tuft of hair from the throat. They live on the banks of the rivers that flow into the Indian Ocean, going south as far as Tana, and west as far as Lake Baringo, preferring the thick, thorny bushes on the overhanging banks of the rivers and brooks. Here they live in small families, which are led by a buck that is generally dark colored. Our engraving shows a young male in two characteristic positions. The horns of the full-grown animal, which are shown, are very similar to those of the large Koodoo antelope. —Illustrirte Zeitung.



THE LITTLE KOODOO ANTELOPE IN THE BERLIN ZOOLOGICAL GARDEN.

Baldness.

The cause of baldness in man is said by Dr. Leslie Phillips to be the fact that he cuts his hair. He says: "In men the hair is habitually cut short from childhood, while in women the converse is almost universally true. In boyhood and manhood, by clipping or cutting the hair, we remove the gentle traction on the bulb and follicle which the natural weight of the hair exercises, and which constitutes the essential and natural stimulus necessary to secure due innervation and vascular supply to the hair-producing structures. Loss of vigor, and finally more or less pronounced atrophy, is the inexorable result, modified or delayed, it may be, by collateral circumstances, predispositions, or conditions." Dr. Phillips warns the "new woman" against wearing her hair short. Almost every theory has some defect, and we might ask Dr. Phillips why men who clip their beard or shave for a long time do not get bald on their chins?—Medical Record.

Up-to-Date Photographs.

Being photographed nowadays is an elaborate process. Heretofore, when a woman wanted her photograph taken, she went to the studio and arranged about the size of the picture and the number she wanted. She gave a reassuring touch to her hair, sat down before the camera, turned her head a little to the right or to the left, as the artist desired, and, clamped on either temple, gazed fixedly, insipidly or otherwise, at a spot on the wall. Now the subject's "possibilities" are studied in detail. Nothing is left to accident. The fashionable woman carries her various gowns to the studio with her, and tries them on, each in turn, that the artist may decide which suits her best. She pays $50 for the photographs.

Her hair is arranged by skillful hands in different ways, that a style of coiffure may be chosen which will be appropriate, not only to the contour of her face and head, but to the environments of the picture. The subject's hands and arms are criticised, likewise her throat and neck, to see whether a severe high costume or an evening gown shall be used. The topics of backgrounds and accessories are discussed.

All of these tinted carbon photographs are taken full length. May be the subject will pose as a dame of the First Empire, with skimpy satin gown, elaborate coiffure, jeweled girdle, fan, and vinaigrette. Perhaps she stands half turned about, with her back to the spectator, and her pure profile deftly brought out on a dark velvet curtain. All women would not look charming in such a position. The artist knows whom to choose, and the subject will wonder at her own beauty when she sees the picture.

A willful coquettish girl is posed as a modern Priscilla. The quaint spinning wheel and high backed chair, the small paned window at the back of the colonial room, form a charming contrast with her rich brocade gown and beaming face. The scant puffed sleeves set off the rounded arms, the curve of the wrist, the hand that grasps the wheel is like a rare old painting, and the undulating outlines of the figure are suggested, not revealed, by the prim folds of the flowered silk frock.

These latter day photographs are like paintings, and are likely never to grow old fashioned. They have the charm that distinguishes the portrait painters of the old English school; a charm that custom will not stale. They will not become out of date and grotesque, like the photographs of twenty years ago, found in family albums. In those days a woman was hired to put the lights in the eyes, color the cheeks, and paint the ribbon bows and artificial flowers of the ladies and the gay neckties and buttonhole bouquets of the gentlemen. The new photographs, be it a hundred years hence, always will be things of beauty, no matter what evolutions, contractions, or diminutions may befall woman's dress.—N. Y. Sun.

The Railroad Kidney.

This complaint is now recognized by medical men. It is caused by an artificial stoppage of the pores of the skin, the dirt of the railroads being responsible for such stoppage. If any person will examine his hand after riding for two or three hours in a train—and this is especially true if he be perspiring—he will find his hand is dirty. But a closer examination will show the existence of a fine grime, the particles of which, so soon as the perspiration ceases, act as minute corks, stopping up the orifices of the pores. How deeply this grime works into the skin is shown by the fact that after a railroad trip one washes one's hands and face two or three times before they become clean. It is this grime which produces railroad kidney. Of course it is not to be supposed that an ordinarily healthy person will contract this disease in any trip of a day or two. But where a person is already a sufferer from chronic disease of the kidneys, it is possible that a week on railroad trains would aggravate his malady to an appreciable extent.

Deep Sea Thermometers.

Thermometers made for taking the temperature in moderately deep waters have the tube incased in a copper cylinder, to protect it from inquisitive fishes and from contact with rocks; there is a ring at the bottom to which sufficient weights may be attached to sink it readily. The cylinder has a long, narrow door in front of the scale, which may be opened for the reading; and this door closes with joints so tight that the cylinder brings up the water from the bottom with its temperature practically unchanged by the waters through which it passes.

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The Depths of Coal Mines.

M. Grousset's proposal to sink a shaft 1,500 m. in depth has attracted general attention to the depths of existing mines. Some American technical journals claim that there is a copper mine in Michigan with a shaft 1,972 m. in depth. M. Haton de la Goupilliere, director of the Paris School of Mines, has been interviewed on the subject by a correspondent of La Nature, to whom he gave some interesting details. From the data in his possession he found the greatest depths of mine shafts did not exceed 1,200 m. Beyond that it was only a question of bore holes. M. L. Poussigue, director of the Ronchamp Mines, in the Haute Saone, has made inquiries as to what were the greatest depths attained in Europe. In Bohemia, at Pibram, he found the Marie shaft with a depth of 1,130 m., the Adalbert shaft with the same depth, and the Franz Joseph with exactly 1,000 m. The Sainte-Henriette shafts at Flenu, near Mons, Belgium, are said to hold the record, with a depth of 1,200 m. Between 1,000 m. and 1,200 m. the temperature of the rock was 45 degrees; thanks to good ventilation, the atmosphere of the pit at that depth was successfully lowered to 20 degrees, although even at that temperature continuous work was trying.

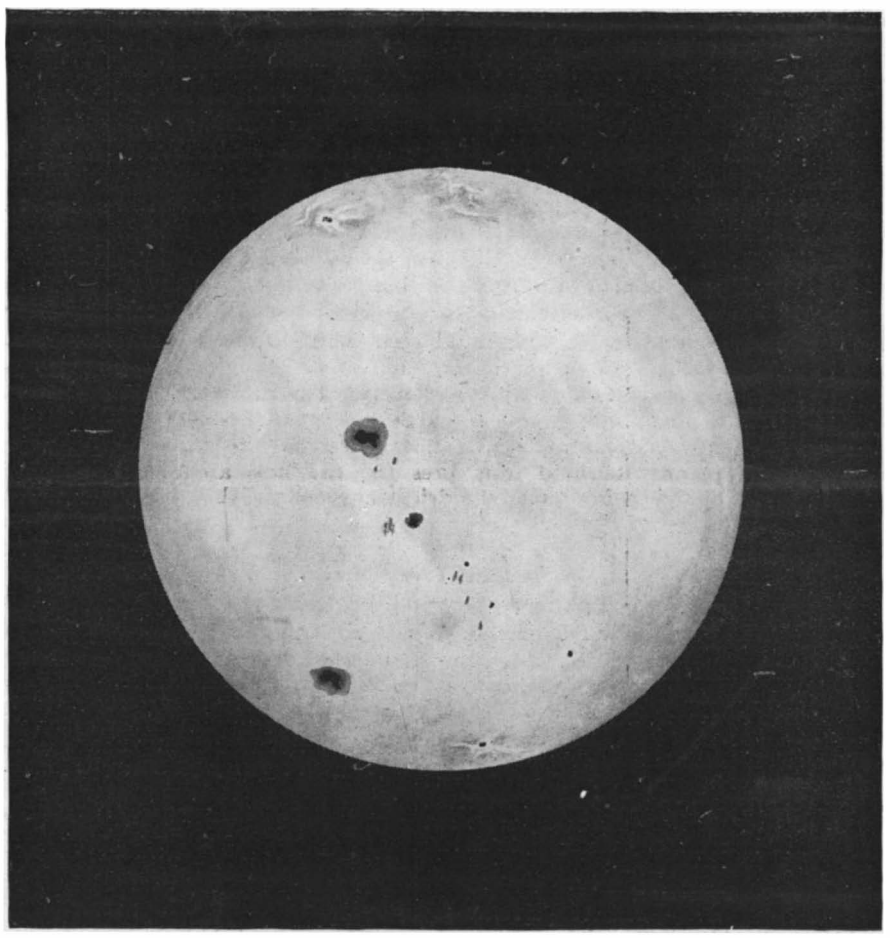
A DRAWING OF SUN SPOTS.

To the Editor of the SCIENTIFIC AMERICAN:

I take the liberty of sending you a drawing of the sun as observed by me, May 19, 5 P. M., with a 3 inch instrument, power one hundred. The two large spots are fine specimens of typical sun spot phenomena, while the faculæ about the developing spots at the edge of the disk seem to afford good examples of the first stages of sun spot development.

L. H. HORNER.

Springfield, Mass., May 20, 1895.



SUN SPOTS.

Telegraphing Without Wires.

Professor A. E. Dolbear, in the Electrical Engineer, says: The increasing interest in the attempts to telegraph without wires both here and abroad makes it worth while to make mention of some facts which have been forgotten or ignored, and I venture to point out that the method which has lately been employed so successfully in England for telegraphing across a sheet of water between three and four miles wide with no connecting cable was fully described by Professor John Trowbridge, of Harvard University, in 1880. He made his original researches between the Observatory in Cambridge and the city of Boston, between which is a time signal wire having the circuit broken by clock once a second. He found he could hear the clock beats a mile away from the line by connecting a telephone to a wire five or six hundred feet long and grounding their ends parallel with the circuit.

His experiments and conclusions are detailed in a paper given before the American Academy of Arts and Sciences and are published in their Proceedings for 1880. How completely he covered this ground of doing telegraphic work by means of earth conduction will be seen by the following quotations from those Proceedings:

"The theoretical possibility of telegraphing across large bodies of water is evident from this survey which I have undertaken.

"Theoretically, however, it is possible to telegraph across the Atlantic Ocean without a cable. Powerful dynamo-electric machines could be placed at some point in Nova Scotia, having one end of their circuit grounded near them and the other end grounded in Florida, the conducting wire consisting of a wire of great conductivity and being carefully insulated from the earth except at the two grounds. By exploring the coast of France, two points on two surfaces not at the same potential could be found, and by means of a telephone of low resistance the Morse signals sent from Nova Scotia to Florida would be heard in France."

This is precisely what is being done in England, carrying out Trowbridge's method. In the various descriptions of methods and operations which I have seen there is no mention of the work of Trowbridge, and whatever merit and utility there may be in this method of doing telegraph work belongs to him. Shortly after the publication of the paper from which I have quoted, Dr. Edward Everett Hale wrote a short story for the Atlantic Monthly in which these earth sheet currents played an important part. Beyond that I have never seen mention of the discovery, for it was a discovery, and an important one too, that slight currents could be detected at relatively great distances from their source by means of a telephone connected to the ground.

The Meccan Pilgrims.*

The Mohammedan pilgrimage to Mecca is a unique custom in the religious history of the world. Notwithstanding the inroads of civilization upon the Orient, 100,000 human beings still undergo the greatest privations in order to kiss the famous black stone which forms part of the sharp angle of the Meccan temple. The benefits of the pilgrimage are great, for the sins of every pilgrim, no matter how dark they may have been, are forgiven by the Almighty, and the supplications of the pilgrim on behalf of others are accepted by God. Such was the teaching of the Prophet.

As soon as the pilgrim reaches the last stage near the sacred city he makes two prostrations in prayer, and divests himself of his worldly raiment. Then he assumes the pilgrim's sacred robe, and sets his heart on Mecca.

The sacred garment called the Ihram consists of two seamless wrappers; one is wrapped round the waist and the other is thrown loosely over the shoulders. The pilgrim's head is left uncovered. After he has assumed the pilgrim's garb he must not anoint his head, or shave any part of his body, or pare his nails. Having entered upon the pilgrimage, he faces Mecca with the devout intention of making the journey to the sacred shrine. Lifting his hands heavenward he cries: "O God, I purpose making this pilgrimage. May the service be easy to me. Accept it from me!" Then, as he proceeds on his journey, he sings the sacred pilgrim song known as the Talbya, which begins with the pilgrim's cry, "Labbaika!" It runs thus:

> I stand up for Thy service, O God, I stand up!
> I stand up! There is no partner with Thee! I stand up!
> Verily Thine is the praise! The blessing! And the Kingdom!
> There is no partner with Thee, O my God!

When he reaches Mecca he bathes himself and then proceeds to the temple and kisses the black stone. He then encompasses the temple seven times; three times at a quick step or run, four times at a slow pace. And each time as he passes around he touches the corner of the temple and kisses the black stone. Being spiritually refreshed, he runs to the top of the little Mount Safa, and, on reaching the summit of the mount, he turns toward the temple at a distance and cries: "Surely God hath aided his servant the Prophet and hath put to flight the armies of the infidel with His own power!" He then runs from the top of Safa to the summit of the Mount Marwah, and this he does seven times. It is an exercise which tries the energy of even the youthful pilgrim, while the white haired pilgrim puffs and blows beneath the excessive weight of his religious devotions.

Upon the seventh day of the pilgrimage the crowd of pilgrims assemble in the great mosque, and at 2 o'clock in the afternoon listen to an Arabic sermon which sets forth the excellences of the "Hajj," as the pilgrimage is called.

On the following day he visits the little valley of Mina, or the "wished for" valley, which Adam longed for when he was turned out of Eden. The next day, after morning prayer, the pilgrim ascends Mount Arafat, or the "Mount of Recognition," about twelve miles from Mecca. It was in this place that our first parents, Adam and Eve, forfeited heaven, and were deprived of their primeval purity for eating wheat. The temptation over, the serpent escaped to Ispahan, the devil to Seistan, and Adam to Ceylon. Mother Evé remained at Arafat, but after wandering many years Adam found his wife on this "Mountain of Mercy," and hence it became known as "Arafat," or the "Mount of Recognition."

The next day is the tenth and is known as the "Day of Sacrifice," and as such is celebrated throughout the whole Mohammedan world. The historian Gibbon wrote of Islam as a religion without a priest and without a sacrifice, a strange error for so accurate a writer. Throughout the whole world this day of sacrifice is observed, and especially at Mecca.

Rising early in the morning, the pilgrim says his prayers and then casts stones at three pillars known as the three devils, the first of which is the "great devil." Holding the pebble between the thumb and fourth finger of the right hand, he throws it at a distance of not less than fifteen feet and cries, "This I do in hatred of the devil." It is said this ceremony was performed by Father Abraham.

Having stoned the devil, the pilgrim then proceeds to perform the sacrifice. The victim may be a sheep, or a goat, or a cow, or a camel, according to the means of the pilgrim. Placing its head toward the sacred stone, its forelegs being bandaged together, the pilgrim stands on the right side of his victim and plunges the knife into its throat with great force and cries with a loud voice: "Allahu akbar"—"God is most great! Accept of this sacrifice, O God!"

The ceremony of sacrifice concludes the Meccan pilgrimage, and the pilgrim then gets himself shaved and his nails pared, and the pilgrim robe is removed. The three days following are well earned days of rest. They are known as the "days of drying up of the blood of the sacrifice." Before he leaves Mecca the devout pilgrim should once more kiss the black stone and throw stones at the devil. He should also drink a cup of water from the Zamzam well, the very well from which Hagar drank when she ran away from home with her son Ishmael.

The pilgrimage to Mecca is known as the "Hajj" and the pilgrim as a Haaji. A visit to Mecca at any other time is called the Umrah. If a Moslem possesses the means of performing the pilgrimage once in his lifetime and omits to do so, it is a mortal sin, and he places himself beyond the possibility of redemption. This doubtless accounts for the popularity of the undertaking.

"He who makes a pilgrimage for God's sake shall return as pure from sin as the day on which he was born. Verily the pilgrimage doth put away poverty and sin just as the fire of a forge removes dross. The reward of pilgrimage is Paradise." Such are the words of the Prophet of Arabia.

The first account in English of the visit of a European to Mecca is that of Lodovico Bartema, an Italian gentleman, who made the pilgrimage in 1503. Only five Englishmen are known to have witnessed the ceremony at Mecca: Joseph Pitts, of Exeter, in 1678; Burckhardt, the Oriental traveler, in 1814; Richard Burton, of the Bombay army, in 1853; Dr. Bicknell, in 1862; and Mr. Keane, a petty officer of a steamship, in 1880. The narratives of each of these pilgrims have been published.

The Meccan pilgrimage was a compromise with Arabian idolatry, and no Moslem writer has ever yet attempted to give a spiritual explanation of its ceremonies. It is one of the most curious circumstances in the history of religion that the superstitious and silly custom of the Meccan pilgrimage should be grafted on to a religion which is monotheistic in its principles and iconoclastic in its practices. The spectacle of the Moslem world bowing in the direction of a black stone while it worships the one true God stamps the religion of the Prophet of Arabia as one of compromise.

* Thomas P. Hughes in the New York Sun.

Fifty Thousand Truants.

The Board of Education of New York City has received a summary of the school census recently taken by the police. According to this report there are 168,020 male and 171,736 female school children in this city. The table shows there are 50,069 truants, which means an expenditure of between $5,000,000 and $6,000,000 for new schools before these delinquents can be taken care of. There is now $6,500,000 available for the erection of new school buildings and it is estimated that twenty-five of them will be required.

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A Sectional Steamboat.

Everybody knows the ingenuity with which the French make preparations for new requirements in their military expeditions, an ingenuity which resembles closely that which the Americans display in their engineering operations for civil purposes. At present the only military enterprise occupying French attention is the establishment of its influence in Madagascar, and Le Genie Civil describes some curious devices which have been invented for the invasion of that country. The capital of Madagascar, Tananarivo, is situated among the mountains of the interior, and is inaccessible, except by footpaths, the government having always prohibited the construction of roads by which artillery could be brought against the city. French armies are, however, not deterred by such trifling difficulties, and a campaign against Tananarivo has been carefully planned. As there are no roads, a river, the Ikonpa, which extends from the sea to the foot of the mountains, just below Tananarivo, is to be used as a road. This river is very shallow and obstructed by sand bars, and the problem is to construct vessels capable of navigating it. This problem has been solved, so far as the gunboats are concerned, by building eight compound boats, or rather rafts. Each of these boats is divided longitudinally into six compartments, each compartment being watertight and independent, so that it can float alone, while, in case of need, any number of them can be bolted together, side by side. These separate compartments, or shells, are of galvanized steel and very light, so that they can be easily transported overland, thrown into the water, and bolted together as they float. When in place, a deck is put over them, on which is placed, near the front, a small boiler of the locomotive type. To balance the weight of this, the engine is set near the rear end of the deck, and is connected directly to a light stern wheel, which serves for propulsion. An upper deck, on which are the pilot house, shields of steel plates for riflemen, and a light cannon, covers the whole extent of the lower deck. All the vulnerable parts of the craft are protected from musketry by steel shields. The whole affair, with stores, crew, and armament, draws less than fifteen inches of water. To provide for passing sand bars, a powerful turbine pump is placed at the very front of the vessel, with a suction pipe which can be lowered as required to any distance less than one meter from the surface of the water. On reaching a sand bar this suction pipe is run out, and the turbine set at work. The sand, mixed with water, is sucked out with great rapidity from in front of the craft and thrown, by a discharge pipe, to one side, and a passage through the bar is in this way soon made.—American Architect.

A LIGHTNING PHOTOGRAPH.

To the Editor of the SCIENTIFIC AMERICAN:

I send you a photograph of lightning, which I made about 11 o'clock on the night of May 5, during one of the most remarkable electric storms ever witnessed in this section of the country. There were three distinct bolts of lightning at the same instant. One of them, after seeming to coil itself around one of the others, darted off to an electric light tower, which stands 150 feet high near the northeast corner of the square occupied by the buildings of the Institution for the Blind, located in this city, and seen in the foreground of the picture.

I send this because I think it will be of interest to you and your readers.

GEO. F. TOWNSEND.

Austin, Tex., May 13, 1895.

American Diggers in Greece.

A gymnasium and other well paved buildings have been uncovered at Eretria, as well as three inscriptions, three heads, and some good architectural fragments. The excavation of the theater has been nearly completed.

The excavations among the ancient Greek ruins at Eretria have been carried on some years by the American School of Classical Studies at Athens. The gymnasium and other buildings which have been uncovered are probably part of the buildings on each side of the ancient street laid bare last year between the theater and the naval school of King Otho.

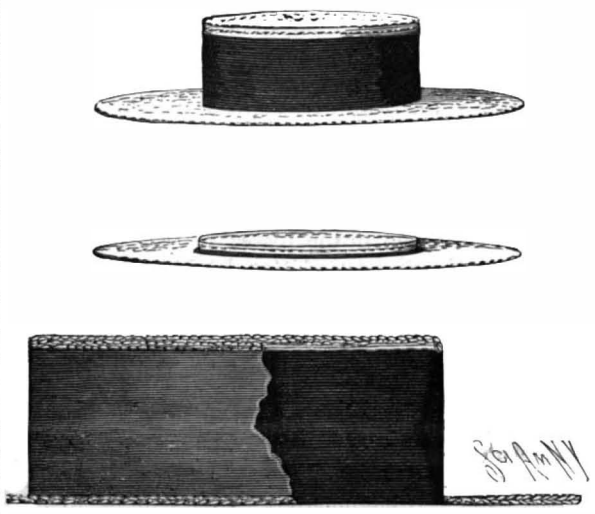
When the houses found last year were cleared a floor of cement and pebbles was discovered about a yard below the surface. The well-paved buildings mentioned by Mr. Peabody are doubtless of a similar construction.

Sales of Patents.

There are a number of concerns that purport to sell patents on commission, but in all cases, so far as we can learn, they induce patentees to pay them money in advance, on which the pretended sellers live, the patents never being sold. The trick is a barefaced swindle. If any of our readers have knowledge of such payments, we should be glad if they would send us the particulars; not for publication, but for private use in establishing the fact of such payments, with view to a remedy.

A STRAW CRUSH HAT.

The high hat of the crush variety is old, but the brilliant genius who surpassed the inventor of the starched necktie in contributing the opera hat to the world of male fashion stopped short at silk and did not venture to produce a crush Leghorn. Such we now illustrate—a Parisian production—uncompromising and hard in appearance as Captain Cuttle's tarpaulin,

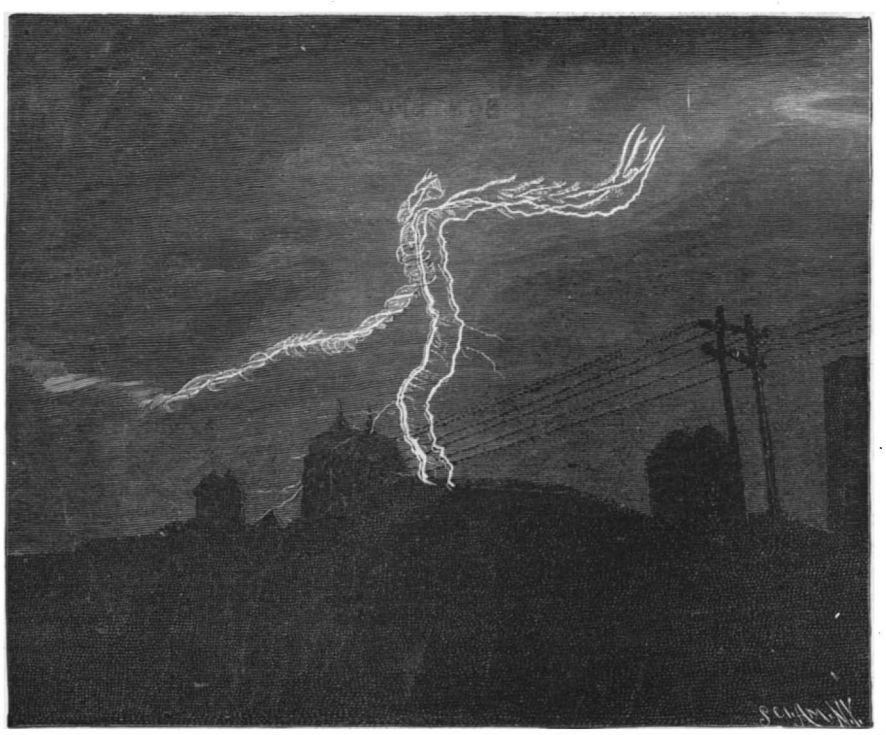


A STRAW CRUSH HAT.

but which, placed beneath the arm, succumbs to pressure; which left carelessly in a chair may receive the avoirdupois of a careless sitter without injury to its anatomy. Like other things in the realm of fashion, it is a deception. The upper crown is straw and the brim is straw; the sides, ordinarily covered with the band, are wanting; the band is there, but there is no substratum of straw. Instead, there is a steel spiral spring, which forces up the crown and stretches the wide band or ribband tightly. The cut, with this description, explains the artifice. When pressed the spring yields and crown and brim come into the one plane. Released from pressure, the sides are forced out to their proper cylindrical contour as the crown rises.

A Cure for Colds.

We are often told that while we may be able to cure consumption or pneumonia, yet we cannot cure a common cold. We desire to state in this connection what we have often said before, that we have a very favorite remedy for all these cases. We have tried it in very many instances and with almost invariable success. The remedy to which we refer is phenacetine. So soon as the patient feels the premonitory symptoms of the cold let him take a hot footbath at bedtime, drink freely of some warm drinks, and take five, seven and a half, or even ten grains of phenacetine. In a strong adult we do not hesitate to give the full dose of ten grains. The result is that the patient has a good night's sleep and awakens in the morning free from pain, while nearly all the symptoms of the cold have disappeared. Of course unusual care must be exercised during the day to prevent the body from becoming chilled.—Medical Compend.



A REMARKABLE LIGHTNING STROKE.

Lessons of the China-Japanese War.

An article in the Marine Rundschau upon the changes in warship building indicated as necessary by the events of the China-Japanese war, and especially of the battle of the Yalu, is most interesting. The writer has collated the various accounts of the events, and has had special information before him, and the table he gives of the damage inflicted upon the ships engaged, and more particularly upon those of the Chinese, illustrates the matter in full detail. A second table sums up the results of the detailed inquiry, and a third describes sundry improvements, mostly of a temporary kind, introduced by the Chinese themselves, such as covering in the barbettes of the Ting-Yuen and Chen-Yuen with light plating as protection against rifle fire, and to shut out the smoke. The conclusions of this writer are that armor protection is more than ever necessary; including gun emplacements, fighting stations, auxiliary engines and also water torpedo rooms. He advocates a complete armor belt, with numerous watertight compartments, and the making an absolute certainty that these last shall be closed as well as all other openings through which water may come in. Finally, he questions the value of fighting masts. Philo McGiffin, a graduate of our Naval Academy, who commanded the Chinese armor-clad at the battle of Yalu River, and who has returned to the United States, is reported as saying that the battle was a stubborn one, and was lost to the Chinese chiefly because they had no shells to use, but only solid shot. The Japanese, he said, were well supplied with shell, which did great execution.

Captain McGiffin, in a recent letter on his experiences with the Chinese navy, writes: "A layman has no conception of the awful nature of battle in modern naval vessels. Even the cruisers have steel sides, and the air of the inclosed spaces is very confined. The din made by the impact of heavy projectiles against these metal sides is awful beyond description. I wore cotton in my ears, but, in spite of that, am still deaf from that cause. The engineers in the Chen-Yuen stuck to their work, even when the temperature of the engine rooms was above 200° F. The skin of their hands and arms was actually roasted off, and every man was blinded for life, the sight being actually seared out. Late in the action, after my hair had been burned off and my eyes so impaired by injected blood that I could only see out of one of them, and then only by lifting the lid with my fingers, I was desirous of seeing how the enemy was delivering his fire. As I groped my way around the protected deck, a hundred pound shell pierced the armor about eighteen inches in front of my hand. In a second, my hand touching the steel was so burnt that part of the skin was left upon the armor. That shows how intense is the heat engendered by the impact of a shot, and how rapidly the steel conducts that heat. One shell struck an open gun shield of the Chen Yuen early in the action, and, glancing thence, passed through the open port. Seven gunners were killed and fifteen wounded by that shot. Early in the fight the Maxim gun in our foretop was silenced. The holes pierced by a shell could be seen from the deck. After the fight we found the officer and men on duty there all dead and frightfully mangled. That one shell had wrought the havoc. The detonations of the heavy cannon and the impact of hostile projectiles produce concussions that actually rend the clothing off. The Chinese sailors deserve all credit for their courage and obedience in that action. No duty was too difficult or dangerous. When the Chen Yuen's forecastle was ablaze from Jap shells, I ordered several officers to cross the shell-swept place to fight the fire. They shirked that duty, but when I called upon the men to volunteer to follow me, they did it promptly, and the ship was saved. It was while on this duty that a shell, passing between my legs, threw me aloft and let me down upon the deck with such violence that I became unconscious, and was out of the fight. All of the officers, however, were not cowards. On my ship were several who had been educated in this country, and they were as brave and devoted as men could be. Others, however, were in the safest place they could find amidships."

A Soap for Cleaning Silk.

A soap for this purpose is made by heating 1 pound cocoanut oil to 96° F., adding ½ pound caustic soda, and mixing thoroughly. Then heat ½ pound white Venetian turpentine, add to the soap, and again mix thoroughly. The mixture is covered and left for four hours, then heated again, and 1 pound of ox gall is added to it and well stirred. Next, pulverize some perfectly dry, good curd soap and add it to the gall soap in sufficient quantity to make it solid—1 or 2 pounds of curd soap will be needed. When cold, the mass should be pressed into cakes.

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Economy to the Consumer of the Incandescent Gas Burner.

BY PRESIDENT HENRY MORTON, PH.D.

During the meeting of the Western Gas Association held in Pittsburg May 15, 16, and 17, a paper was read on the subject of incandescent gas lighting, which, with the discussion following it, conveyed much of a comforting as well as interesting character to the general reader or rather general gas consumer.

The author of the paper in the first place had many things to say in disparagement of the Welsbach incandescent gas burner, from his standpoint as a gas manufacturer, on the ground of its reducing the output and profit of the gas company under his charge, by affording those who used it an increased amount of light at about half the cost of the ordinary burner.

In the course of the discussion which followed, the same gentleman gave some illustrations, as for example: "We have a club room in our city which used 81,400 cubic feet of gas from January 1 to May 1, 1894. On January 1, 1895, we replaced the burner commonly used there with Welsbach burners, and from that time to May 1, 1895, they used 35,400 feet—a loss to us of 46,000 feet, or over 50 per cent on one customer in six months."

From the point of view of this manager of a gas works, this was truly disheartening; but how about the club in question or consumers generally? To these we think the statement will convey nothing but pleasure, qualified by the consideration that it is almost "too good to be true."

If any such statement came from the Welsbach Company or any one interested therein, it would carry little weight, but coming from one who is manifestly an enemy and in deadly earnest, it is equally convincing and encouraging to the gas-consuming public.

It may however be asked, Is this benefit to the public to be secured only at the expense and perhaps by the ruin of the gas companies? For, if this is so, it may in the long run be of doubtful advantage even to consumers.

To this question an abundant answer was given in the discussion which followed the paper on incandescent gas lighting.

In this discussion a large number of the managers of gas works present took part, and without exception each one in turn, while indorsing the statements of the paper as to the advantage to the consumer, emphatically denied the deduction as to injury to the business of the gas companies under their charge.

They all showed, from their own experience, that while the introduction of the Welsbach burner had often in the first instance and for a short time diminished the total amount of gas used, this influence was promptly reversed by reason of the additional customers secured and light used, through replacement of oil lamps by the economical and brilliant Welsbach, and its displacement of electric lamps both arc and incandescent. Indeed, the only note of distress heard in this connection was one intimating regret that the business of supplying Welsbach burners was not in all cases in the hands of the gas companies.

A full account of this paper and discussion was published in the American Gas Light Journal for May 27, and is interesting reading to the gas consumer who has an eye to economy.

It is not often that any one can point to the fulfillment of a quasi-prediction, and it is, therefore, with pleasure that I find in the report of a paper which I read before the Society of Gas Lighting on January 17, 1889, the following words:

"The mere cheapening of gas I contend is not the only or the scientific method of correcting the manifest wastefulness of our present methods of using it to produce light. It would be like saying that to secure cheap fuel was the right way to improve the steam engine. In the case of gas, such a policy, if persisted in, can only result in relegating gas to the cellar, the kitchen, and the engine room, to warm us, to cook our food, and to drive our machinery; and in replacing it as a means of illumination by electricity, which may, in time, owe its very existence and life to the enslaved labors of its deposed rival imprisoned in the furnace of the steam engine or laboring blindly in the cylinder of the gas engine.

"I believe that gas, much as it has been abused, deserves a better fate, and will secure it if anything like the attention is given to its education and refinement, as an illuminating agent, which has been lavished upon its impalpable rival, electricity.

"I believe that a good beginning at least has been made in this direction by Dr. Auer von Welsbach and those who have been developing and improving his very original invention; and it, therefore, gives me pleasure to bring before you this evening (among other recent developments in artificial illumination) a number of the burners known by the name of Welsbach, in the latest form to which the process of gradual improvement has brought them, and to point out to you what I have found in my own experience as to their actual merits or probable future advances."

As illustrating the present attitude of the gas companies toward the Welsbach light, it may be noted that, at the conclusion of the discussion above referred to, a vote of thanks was passed to Herr Auer von Welsbach for his discovery and production of the gas burner bearing his name.

Electric Canal Towage.

Canal barges have recently been very successfully towed by electric power on the summit level of the Canal de Bourgogne. This portion of the canal is 3¾ miles long and has been made very narrow to reduce construction expenses. There is no tow path, and hauling is effected on the submerged chain principle. The hauling upon the chain is now done by electric power instead of by steam, as heretofore. A generating house has been fixed at each end of the section, the current being generated by water power. The dynamos at the two stations, 3¾ miles apart, are coupled in series. The three mains are suspended on rubber insulators in part from wires spanning the canal and in part from the tunnel roof of the tunnel sections of the canal. Trolley arms of the usual type are used. The motor used on the tug which hauls upon the submerged chain is of 19 horse power, running at 900 revolutions per minute. During the passage through the tunnel the current is utilized to light the boat, and at night is used for this purpose during the entire run. The cost of the plant was about $27,000, and a saving of $800 a year is recorded.

RECENTLY PATENTED INVENTIONS.

Engineering.

COAL DUST AND AIR FIRING.—Constanz Schmitz, Berlin, Germany. This invention provides a method of and apparatus for mixing coal dust and air in proper proportions for feeding to a furnace to obtain perfect combustion, the coal dust being fed into a chamber where air is in motion, and where the impurities may be separated from it, while by means of a blowing engine the mixed coal dust and air, through a connection with a feed device, are fed to the fire, the velocity of the air maintaining in suspension just the quantity of coal dust which can be burned in the most advantageous manner under the conditions presented.

VESSEL STEERING APPARATUS.—Sebastien Lacavalerie, Caracas, Venezuela. This is an apparatus especially adapted for use in connection with a vessel of conical shape, adapted to go below the surface of the water, forming the subject of another patent issued to the same inventor. It is designed to facilitate steering the vessel either up or down, or to one side or the other, or to cause it to progress in a sinuous line. The apparatus comprises a box projected beyond the vessel and capable of revolving in its seat, a shaft carrying a rudder being mounted in the box and capable of turning with it, while the box and shaft are operated by mechanism within the vessel. Rudders are mounted on the sides of the vessel and operatively connected with each other, there being also a bottom rudder and an end rudder rotating about vertical axes.

Railway Appliances.

BRAKE SHOE.—James E. Worswick, Americus, Ga. This is an improvement on a former patented invention of the same inventor, and provides a combined brake shoe and dresser, the body of the shoe of soft metal, with transverse cutting faces of harder material extending flush with the outer face of the shoe, the shoe being of greater width than the tread of the wheel, and the outer edge of the cutting faces overlapping the rim of the wheel. The improvement is designed to keep in true shape the entire wearing face of the wheel, from the throat of the flange to the outer edge of the rim.

SWITCH ADJUSTER.—John Kortan, Jr., Detroit, Mich. This is a simple and inexpensive device for use on all kinds of street railways, for adjusting the swinging tongues of frogs without requiring the operator to leave the car. It comprises a vertically movable rod at the lower end of which is a blade having curved fingers extending on each side, and the rod having a handle with the same set as the blade.

RAILWAY SWITCH.—Louis V. Johnson, Brooklyn, N. Y. This switch is to be worked by contact of the wheels with a shifting device on the rails, but which may be passed over without working the switch if desired, the car automatically opening the switch if desired, and closing it after the car has passed. Combined with the switch point is a horizontally sliding shifting plate with a flange at each end, the flanges projecting above the tops of the rails for contact with the car wheels, and there being intermediate mechanism between the plate and switch point for operating the latter from the plate.

CAR FENDER.—Rafael Mayolini, New York City. This is a bow fender, readily transferable from one end of the car to the other, and made in two spring sections, which, when curved, brought together and locked, are designed to completely guard the front of the car, the front and sides of the fender being cushioned to prevent injury to any one caught upon it. The connected fender sections may be quickly disconnected from the car platform, when the spring frames throw the sections outward, carrying with them to the sides of the track any interfering objects.

CAR FENDER.—Edward L. Kelly, Philadelphia, Pa. This fender consists of a wheel mounted on a vertical spindle carried by a bracket at the front edge of the car platform, the wheel extending horizontally entirely over and beyond the track rails on each side, and having an effective gripping surface at its periphery, to make a good hand hold for a person falling upon it. The wheel may be rotated in either direction to carry one to the side of the track, and the front edge of the platform above the wheel is covered by a buffer, with side cushions, to prevent injury to one falling upon the wheel.

Mining.

MINING MACHINE.—Frank S. Dobson, Vancouver, Canada. For raising gold from rivers, bars or flats, this inventor provides a vertically movable caisson in which is a central pump and agitator, with appliances whereby the water from the stream may be made to force the material to the pump and assist the agitator in removing it, or the water may be introduced to the pump and the agitator under pressure from the support of the caisson. All the interior parts of the caisson may be removed, leaving a clear shaft within which a miner may descend to prospect or run a drift or tunnel

Mechanical.

STONE CUTTING MACHINE.—John G. Kouhoupt, Jersey City, N. J. According to this invention a frame carries a stationary anvil provided with converging slideways in which knives are removably fitted, while a reciprocating die in the anvil-carrying frame has cutting edges registering with the knives of the anvil. This machine is very simple, and may be constructed as an attachment to an ordinary trip hammer. It is designed for rapidly splitting and cutting stones, and is especially adapted for forming cobble stones or other small stone blocks.

COATING AND PRINTING PAPER.—James E. Gledhill, New York City. Two machines are arranged side by side for this work, according to this invention, one receiving the paper from the other, two rolls arranged at right angles to each other being arranged in the path of travel of the paper between the two machines, the paper passing first under one roll and over it in a transverse direction, and under the second roll and over its top, to pass in a parallel direction to the second machine.

DRIVE WHEEL FOR ELEVATORS, CARRIERS, ETC.—George S. Fouts, San Jose, Cal. According to this improvement the pulley supports movably connected clamping sections which may move into and out of binding contact with the cable, to permit the cable to move freely between the sections as it moves into contact with the wheel, and then to cause the sections to press upon the cable during a portion of the revolution of the wheel, thus driving the cable without any slipping. The device adjusts itself to carrier flights or other projecting portions on the cable, or to sticks or other obstructions between them and the band clamping sections.

Agricultural.

PNEUMATIC STACKER.—Thomas Kirshman, California, Mo. For effectively carrying the straw, chaff, etc., from the discharge end of a thrashing machine to any desired place, this invention provides for a vertical fan to be secured to the rear end of the machine over the discharge opening, the opening becoming the eye of the fan, into which the straw and chaff are discharged, to be driven from the fan into and through an appropriate discharging trunk or chute. The discharging pipe has an elbow mounted to turn and loose sections connected by links, and may be raised and lowered without disconnecting the sections.

INCUBATOR.—Norman McAslan, Briggs, Neb. The case of this incubator has a series of egg compartments in which the egg trays are so arranged that the eggs may be subjected to different degrees of heat, according to the length of time which the eggs have been in the incubator. An improved method of ventilation is provided, and the heating apparatus is so arranged that the temperature may be controlled to a nicety, the heat being regulated by a thermostatic device.

Miscellaneous.

BICYCLE DRIVING GEAR.—Thomas M. Crepar and Hugh Hunter, Clare, Mich. The pedals are arranged to move up and down in the segment of a circle, according to this improvement, instead of the rider being compelled to follow the pedals with the feet in a circle, a simple transmitting mechanism actuated by the pedal levers imparting a rotary motion to a driving sprocket wheel of the ordinary kind. The simple up and down movement of the feet, with the use of a large sprocket wheel, is designed to facilitate the attainment of great speed with the least effort.

BICYCLE HABIT.—Herbert Luey, Brooklyn, N. Y. This improvement comprises a skirt divided at the back and made with folds at the rear which are combined with interior partitions forming leg portions. When the garment is in use the limbs are free to work the pedals, the folds falling on each side of the saddle, and when the rider steps from the machine the rear folds close into the appearance of an ordinary skirt, no difference from which can be detected either at the front or rear.

UMBRELLA FRAME.—Daniel H. Redmond and Chalkley B. Baldwin, Philadelphia, Pa. This invention provides an extremely simple method of forming the joints connecting the umbrella ribs with the stretchers or braces by the employment of a light and efficient clip, whereby the rib is strengthened in what has heretofore been its weakest point, and may be made very light.

FOLDING UMBRELLA.—Frank G. Grove and Don P. Lillard, Luray, Va. This is an improvement upon a former patented invention, providing an extensible brace which is easily operated, cheap and very strong. The stick is made up in sections screwed together, and each brace comprises a hollow inner section and an outer section, the sections sliding upon each other. When the umbrella is spread the braces slide out until the springs catch and lock the cover in extended position, and in folding the stick is reduced to compact shape, the tip removed, the braces collapsed and the cover folded in.

FENCE WIRE STRETCHER.—John O. Walton, Belle Vernon, Ohio. To draw and tighten fence wire without making short bends which might injure the wire, this inventor has devised a simple device which may be readily attached to a fence for this purpose without cutting the wire or taking it down from its fastenings. The device has a central cast iron hub-like portion from which project wings with narrow throat-like ways, so arranged that by turning the hub in either direction by means of a wrench, in using the improvement, the throat ways pass over the wire strand and wind it about the hub until the desired tension is attained.

SWIVEL COUPLING FOR VEHICLES.—Brown Henley, Hillsville, Pa. This is an improvement designed for employment in the front axles of carriages and wagons, the lower member of the coupling having opposite recesses in the outer side of its exterior circular flange, and the upper member having opposite notches in the edge of its outer flange to engage the lower member. The clips employed have claws fitting the notches and entering the recesses, the latter being elongated to allow of some lateral movement of the claws. The clips serve as stops, limiting the degree to which the axle may turn, and also secure the axle to the spring, preventing lateral movement of the latter without weakening it.

COMBINATION TABLE.—Francis J. Merceret, Baltimore, Md. A table adapted to inclose and hide a gas stove, or form a base for it in use, has been patented by this inventor. It has a hollow body with a longitudinal partition, and across the partition are guideways on which is an adjustable sliding dish shelf, the top being made in two parts, hinged at about the middle. Besides its use as a kitchen table when opened, it may serve as a library or sitting room table when closed up, being especially designed for use in light housekeeping in flats or apartments.

MATTRESS.—Morris Rude, New York City. This mattress presents special conveniences for handling while turning or airing, and is arranged to be bound loose or tight, as may be desired. It has a string alternately engaging part of the top and part of the bottom, the drawing upon the string compressing the mattress at opposite faces. The string is drawn through different sets of eyelets, and thus forms several transverse series of loops on the top and bottom faces of the mattress.

COPYING BOOK BRUSH CUP.—George J. Wohltman, New York City. This is a narrow, pan-like vessel with a cover across one end and a grating extending nearly its whole length just over the water. The grating is removable to facilitate cleaning, and the brush, when not in use, is ordinarily laid flat on the grating.

HOT WATER FURNACE.—Edwin F. White, Hollidaysburg, Pa. A horizontal partition forms the top of the fire box of this furnace, and there is a chamber under the grate at its front end and connected with the water return pipes, pipes leading from the chamber extending under the bars of the grate to the rear of the bridge wall and then upwardly, each pipe then forming a horizontal coil under the partition, over which is a second coil discharging into a chamber connected with the outflow pipes. The construction is designed to afford quick circulation and utilize the fuel to the fullest advantage.

HEEL.—William Wass, Philadelphia, Pa. This invention relates to the employment of detachable wear plates upon boot and shoe heels, and provides an attaching plate fastened to the heel proper and a wear plate held in locking engagement with, but removable from, the attaching plate. The wear plates are inter-

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changeab.e as rights or .efts, so that the plates may be worn down evenly.

CAROUSEL.—Milton T. Weston, Kenton, Ohio. In the construction provided for under this patent the carriages may swing outward from their supporting arms at angles varying with the velocity at which the revolutions are made. Each carriage is also provided with its own driving mechanism, operated by pedals by those occupying the carriage, and all the carriages being connected with a multiple drum, one section only of which is connected with one carriage.

TRUSS.—Douglas Reid, New Richmond, Wis. This truss is designed not to bind the hips or interfere with the free movement of the limbs. The pressure of the pad may be regulated by drawing together the rear portions of the band, the springs being designed to afford only the lightest necessary pressure.

WATER CLOSET FLUSHING TANK.—Richard A. L. Blondel, Boston, Mass. According to the improvements covered by this patent, the discharge valve, valve seat and attachments are removably and adjustably connected with the "spud" in the bottom of the tank, and the disagreeable sound caused by the passage of air through the overflow pipe at the time of discharge of water from the tank is prevented. The flushing or main discharge valve is automatically locked and held open for a certain length of time, and then released and caused to close slowly and noiselessly.

CASTRATING FORCEPS.—Ned Farish, Jackson, Miss. This is a tool in which a medicated sponge is held on the upper jaw in front of the knife to reduce loss of blood and obviate the use of clamps, etc.

Designs.

INLET VALVE CASING.—Richard A. L. Blondel, Boston, Mass. This design comprises a horizontal flange or extension of the body of the valve casing in connection with a vertical cylindrical offset arranged beneath and joined with the flange.

BRUSH BACK.—Charles Osborne, New York City. This back is ornamented with forget-me-nots and conventionalized floriate scrolls framing a plain surface, with festoons beneath a shell-like figure at the top of such surface.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

SCIENTIFIC AMERICAN

BUILDING EDITION.

JUNE, 1895.—(No. 116.)

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1. A cottage at Bronxwood Park, Williamsbridge, N. Y., recently erected for Dr. Geo. P. Shirmer, at a cost of about $2,500. Perspective elevation and floor plans. A pleasing design. A. F. Leicht, Esq., architect, New York City.
2. An elegant plate in colors showing a cottage at Bronxwood Park, Williamsbridge, N. Y., recently erected at a cost of $2,200. Perspective view and floor plans. Mr. A. F. Leicht, architect, New York City. A neat design.
3. A cottage at Flatbush, L. I., recently erected for W. K. Clarkson, Esq., at a cost of $5,000. Perspective elevation and floor plans. Mr. Christopher Myers, architect, New York City. A picturesque design.
4. A modern cottage at Bedford Park, New York City, recently erected at a cost of $3,000. Perspective elevation and floor plans. A picturesque design. Mr. Edgar K. Bourne, architect, New York City.
5. The Bedford Park Congregational Church. Two perspective elevations and floor and basement plans. Cost complete, $7,000. Mr. Edgar K. Bourne, architect, New York City.
6. A Colonial cottage recently erected at New Dorp. S. I., at a cost of $3,675, complete. Perspective elevation and floor plans. Messrs. Child & De Goll, architects, New York City. An attractive design.
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9. Design for a window decoration.
10. The residence of E. P. Sandford, Esq., at Montclair, N. J. Two perspective elevations and floor plans. An elegant design. Architect and builder, Mr. E. P. Sandford, Montclair, N. J.
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12. Miscellaneous contents: The Hanging Gardens of Babylon.—Perspective drawings.—Concrete roofs.—Points of support.—Architects' estimates.—An improved hot water heater, illustrated.—A new invention for raising water, illustrated.—Improved paving.—The Bommer spring hinge, illustrated.—A mixing regulator for gas machines, illustrated.—Adjustable sliding door track and hanger, illustrated.—Woodworker's improved vise, illustrated.—African mahogany.—A new steam and hot water heater, illustrated.—Powers' improved automatic chimney top, illustrated.—Improved wood working machinery, illustrated.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
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Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(6550) F. W. L. asks: 1. What is a good dressing for leather belts, also for rubber belts? A. Lubricator for Belts.—Five parts of India rubber are cut fine and melted together with 5 parts oil of turpentine in an iron, well covered vessel; then add 4 parts of resin, stir well, melt, and add 4 parts of yellow wax, stirring constantly while melting. This mixture while warm is added, with constant stirring, to a melted mixture of 15 parts fish oil and 5 parts of tallow, and the whole is agitated until it has congealed. The mass is applied to old belts upon both sides in a warm place, and when the belts are in use, from time to time upon the inner side. By this treatment they become very durable. 2. How can I make a good cement for holding the splices of a leather belt? A. Leather Belting, Cement for.—Take of common glue and American isinglass, equal parts; place them in a boiler, and add water sufficient to just cover the whole. Let it soak ten hours, then bring the whole to a boiling heat, and add pure tannin until the whole becomes ropy or appears like the white of eggs. Apply it warm. Buff the grain off the leather where it is to be cemented; rub the joint surfaces solidly together, let it dry a few hours, and it is ready for practical use; and if properly put together, it will not need riveting, as the cement is nearly of the same nature as the leather itself. 3. What is the best commutator lubricant? A. Heavy petroleum oil applied very sparingly with a cloth slightly moistened with the oil. 4. How can I find the horse power of a common slide valve engine? A. Horse Power of Steam Engines.—Multiply the square of the diameter of the cylinder in inches by 0·7854, and this product by the mean engine pressure, and the last product by the piston travel in feet per minute. Divide the last product by 33,000 for the indicated horse power. In the absence of logarithmic formulæ or expansion table, multiply the boiler pressure for ⅝ cut-off by 0·91, for ½ cut-off by 0·85, ⅜ cut-off by 0·75, 3-10 cut-off by 0·68. This will give the mean engine pressure per square inch near enough for ordinary practice, for steam pressures between 60 and 100 pounds, always remembering that the piston travel is twice the stroke multiplied by the number of revolutions per minute.

(6551) N. A. D. writes: In getting ready to start our engine, we found that the valves would not work. We removed the cylinder head to ascertain the cause, and we found four of the bolts broken, or the heads snapped from the bolts that hold the following head. The engine was left at half stroke, and the force was great enough to fly from the following head down to bottom valves. No water or ice in cylinder. Corliss engine, one hundred and eighteen horse power. I am at a loss to know the cause of the breakage. Will you explain? A. The breaking of a follower bolt is not unusual, but that four should break at the same time is inexplicable. Possibly they have not broken at once, but consecutively, and taken refuge in the exhaust valve until their number made an obstruction.

(6552) P. J. M. asks what the word horizon means in patents. A. It means the same as it does in any connection, i. e., the most remote visible limit of the earth's surface, or a line parallel with that limit where it adjoins the sky.

(6553) M. E. K. asks how pipes can be stopped leaking where they screw in the fittings on a hot water system. I am having some trouble with them and cannot stop the bad ones. A. The leaky pipe joints show bad work in putting together. Clamps can be made to fit the joints and bolted on with packing of iron putty or rubber. The correct way is to take the work apart and make up the joints properly.

(6554) C. A. B. writes: 1. In the electric chime described in Hopkins' "Experimental Science" page 814, are the bells all of one size or will it be necessary to make a pattern for each? A. The bells are of different sizes. You could doubtless save money by purchasing the bells ready tuned. 2. How much wire will it want on the spool of the magnet for a bell with a 6 inch rim? A. Probably ½ ounce of No. 24 wire on each spool will be right for a battery current.

(6555) S. W. asks how fast a boat 12 feet long, 33 inches beam, using a 6 inch 2 bladed propeller, can travel in calm water. The boat is good model. For motive power I wish to use the simple electric motor described in SUPPLEMENT, No. 641, running it with 4 cells of storage battery. How long can I run the boat and shall I use a flat or round belt? A. Four miles per hour is as much as you can expect with the motor and battery named. You should have not less than 6 cells. We do not recommend a belt. Use cut gearing and bring the shaft down to the motor. You may run from 6 to 8 hours.

(6556) F. H. writes: Suppose a circular piece of metal 2½ inches diameter, and of certain thickness, weighs 10 pounds. How to find the weight of a double diameter (5 inches) piece of same thickness as former, then weight of a triple diameter, etc. A. The weights are as the areas. For the area, square the diameter and multiply by 0·7854. Twice the size is four times the weight for equal thickness.

(6557) J. B. B. writes: A young mechanic made the assertion the other day that if a gage was put under the bottom of a steam boiler and the boiler was put in use, the gage would only show the pressure of the water. I should think that the gage would show the pressure of the water plus the pressure of the steam. A. The gage will show the steam pressure added to the water pressure, as you suggest.

(6558) S. W. L. says: Will you please publish in your query column a receipt for making printer's tablet glue? A. The compositition is said to be prepared as follows: Glue, 4 pounds; glycerine, 2 pounds; linseed oil, ½ pound; sugar, ¼ pound; aniline dyes, q. s. to color. The glue is softened by soaking it in a little cold water, then dissolved together with the sugar in the glycerine, by aid of heat over a water bath. To this the dyes are added, after which the oil is well stirred in. It is used hot. Another composition of a somewhat similar nature is prepared as follows: Glue, 1 pound; glycerine, 4 ounces; glucose sirup, about 2 tablespoonfuls; tannin, one-tenth ounce. Give the composition an hour or more in which to dry or set before cutting or handling the pads.

NEW BOOKS AND PUBLICATIONS.

MONETARY SYSTEMS OF THE WORLD. A study of present currency systems and statistical information relative to the volume of the world's money. With complete abstracts of various plans proposed for the solution of the currency problem. By Maurice L. Muhleman. 1895. New York: Charles H. Nicol. Pp. 198. Price $2.

A great amount of very curious and interesting information is contained in this work. We do not care to investigate the author's private views, but the simple information as to the standard coins of different countries is of much interest, and the archæological point, that it is very difficult to supplant a coin of long acceptance, is brought out very clearly in respect to many lands. It really seems strange that mankind should be willing to live in so confused a state as regards measures and weights, and Mr. Muhleman's book is merely another demonstration of the fact that it is very hard to bring about a change for the better.

THE BROWNIE SONG BOOK. A book of brownie songs for children (young and old). Words and music written, composed and adapted by S. G. Pratt. London: Stanley, Lucas, Weber & Co. Chicago: Laird & Lee. Price 50 cents.

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An experience of nearly fifty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

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June 4, 1895,

AND EACH BEARING THAT DATE.

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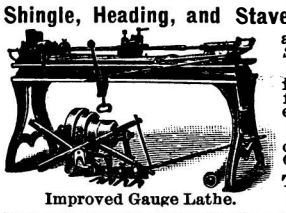

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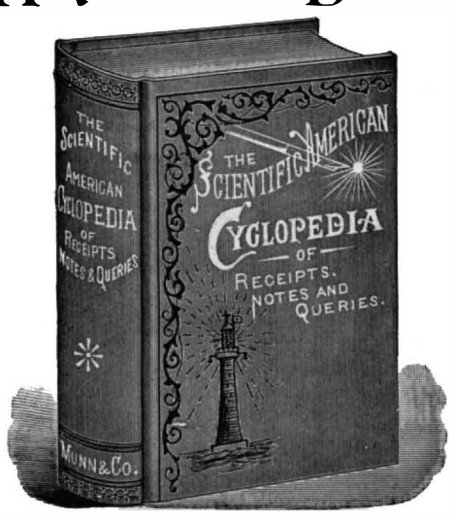

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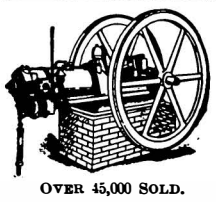

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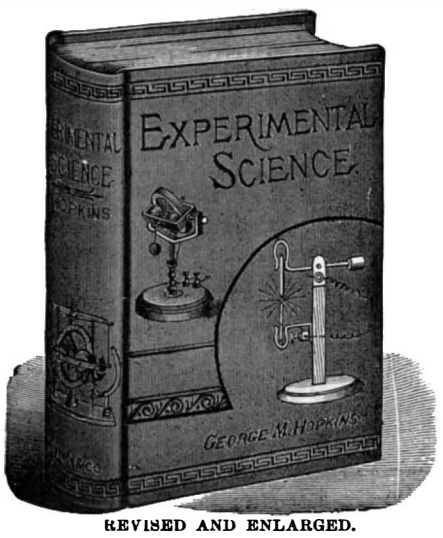

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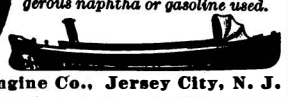

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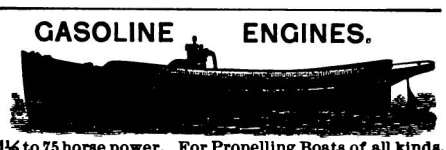

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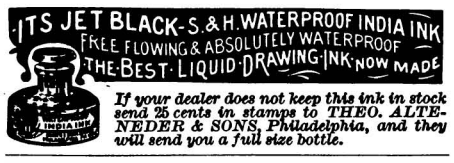
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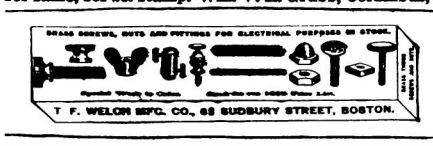

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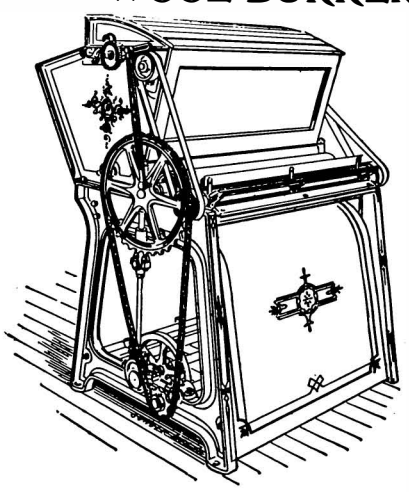

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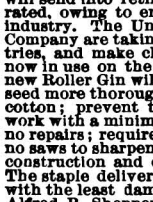

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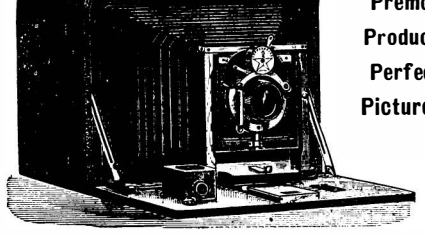

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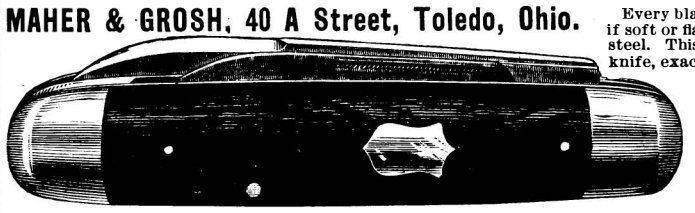

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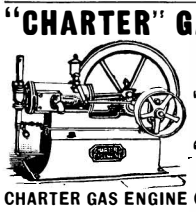

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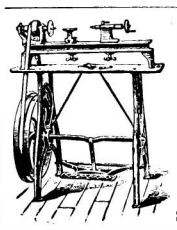

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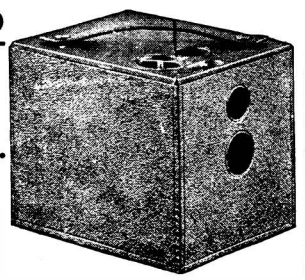

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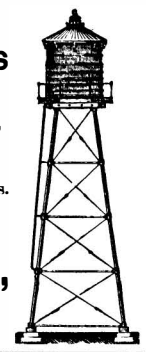

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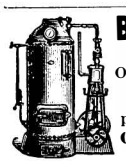

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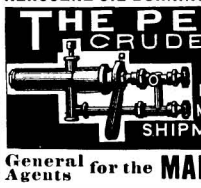

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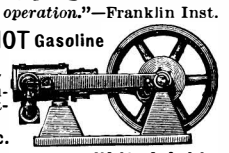

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